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George Edward Young,  
from  
Richard Sennings Armstrong, M.E.I.C.S.  
the Author's Son.

November 17th 1857.

THE  
INFLUENCE OF CLIMATE,  
ON THE  
HUMAN CONSTITUTION.



THE  
INFLUENCE OF CLIMATE,  
AND OTHER AGENTS.

ON THE  
HUMAN CONSTITUTION,

WITH REFERENCE TO  
THE CAUSES AND PREVENTION OF DISEASE,  
AMONG SEAMEN:

WITH  
OBSERVATIONS ON FEVER IN GENERAL,  
AND  
AN ACCOUNT OF THE EPIDEMIC FEVER OF JAMAICA,

BY  
ROBERT ARMSTRONG, M.D., F.L.S.,  
DEPUTY INSPECTOR OF HOSPITALS AND FLEETS, &c.

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..... Ne incognita pro cognitis  
habeamus, hisque temere assentiamur.

*Cicero de Officiis, Lib. 1.*

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LONDON :  
LONGMAN, BROWN, GREEN, AND LONGMAN :  
E. W. COLE, STONEHOUSE.

21.A.1843.1

TO

THE RIGHT HONOURABLE  
THOMAS, EARL OF HADDINGTON,

FIRST LORD OF THE ADMIRALTY.

MY LORD,

In dedicating the following pages to your Lordship, it is with a conviction, that any efforts, however humble, which have for their object the preservation of the health of our Seamen in warm climates, will meet with approbation.

Placed at the head of the Naval Administration of this great Empire, and assiduously devoting the energies of a vigorous and enlightened mind, to promote the welfare of that most important branch of the public service over which you preside, I was anxious, that the following observations should appear under the sanction and auspices of your Lordship; and more especially, when it was at the magnanimous suggestion of the Inspector General of the Medical Department, that I solicited the honor of being permitted to do so.

Having passed the earliest, and most valuable years of my life in the Naval Service, and been placed in

situations affording facilities for observation, which fall to the lot of but few; I endeavoured to take advantage of my position, and now consider it a duty which I owe to the Service, to communicate the result of that experience, in the hope that it may prove beneficial to others.

Appointed, at an early period of life, to the charge of the Naval Hospital at Jamaica, at the recommendation of the Medical Commissioners, during the Naval Administration of Lord Melville, I considered, that the best proof I could afford that their selection had not been unfortunate, consisted in the efficient discharge of those duties, to which their Lordships had been pleased to appoint me.

With feelings of gratitude, therefore, for the opportunities afforded me, and also, for the kind and courteous treatment I have ever received from My Lords Commissioners of the Admiralty, and from the Inspector General, during their official visits to this Hospital, I beg to subscribe myself,

My Lord,

Your Lordship's

Faithful and obedient Servant,

ROBERT ARMSTRONG, M.D.,

*Deputy Inspector of Hospitals.*

Royal Naval Hospital,  
Plymouth, December 12th, 1843.

## P R E F A C E .

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IN submitting the following observations to the Public, it may not be superfluous to explain the circumstances under which they were originally drawn up, and the object for which they were intended. When in charge of the Naval Hospital at Jamaica, a circular order was issued, directing the Principal Medical Officers of the Naval Hospitals, at Portsmouth and Plymouth, to deliver, during the summer months, a course of Lectures to the Medical Officers serving in the ships-of-war in Port, and in the Hospitals. As it was expected that a similar order would be extended to the Foreign Hospitals, it was considered prudent to make preparations for the contemplated new duty, and avoid being taken by surprise. I was further induced to undertake this task, from advices I received through a private channel, that there was every probability of my being removed to England, to undertake the duties of Lecturer at one of the Naval Hospitals.

The first consideration was, how these Lectures should be framed, so as to render them generally interesting, and at the same time, practically useful. As a

course of Lectures, strictly Clinical, would be interesting to those only, who had daily opportunities of seeing the Patients, it was considered necessary to take a somewhat more extensive range, and introduce subjects of a more general nature. From my intimate connexion, and constant intercourse, with the Surgeons of our ships-of-war, I was aware of the kind of information they required; and more especially the junior branches, who are frequently appointed to Hospitals, on their first entrance into the Service. Having completed the prescribed course of study in the Medical Schools, they had not yet acquired practical experience: their knowledge was derived from books, and their minds were often imbued with certain theoretical opinions, which time and observation alone could remove. It appeared also, that but little attention was paid to the various causes, which come into operation in the production of disease amongst a ship's company; and that certain opinions passed current, the truth of which was never questioned.

As one of the most important duties of the Surgeon of a ship-of-war, consists in the adoption of such means as are best calculated to preserve the health of the seamen entrusted to his care; it becomes an object of the utmost importance, that the means he recommends to his non-professional superior, are founded on correct principles, and deduced from a knowledge of the exciting causes of disease. Seasoning to the Climate, Malaria, &c., are often used as certain cabalistical terms to explain every thing, without any very precise ideas being attached to their nature, or mode of operation. The former term is generally understood to imply the power of resisting heat, as the result of habit, without any

reference to those Physiological changes in the constitution, which when fully established, constitute that power of accommodation. When Fever makes its appearance in a ship in harbour, Malaria is the cause assigned, especially if a little mud, or a few patches of brushwood, are found on the shore, perhaps, some miles distant. The seaman, on whom these influences are supposed to produce injurious effects, seems to be regarded as a passive agent ready to receive impressions ; whilst but little importance is attached to the various conditions under which he is placed, and the modifications produced in the physiological state of the functions of life. Of the extent of these modifications, we have the most striking proofs, in the variations observed in the physical characters of the different tribes of mankind. Comparative Anatomy also affords many analogies, amongst the different tribes of animals, of the intimate relation which exists between external agents, the organization, and physical necessities of the individual.

Another object kept in view was, to create habits of thinking among the Junior Medical Officers,—to induce them to store their minds with useful information,—to take advantage of the opportunities afforded them, of promoting the interests of science, and to apply to purposes of practical utility, the theoretical knowledge they had acquired in the medical schools. The field was extensive, and comparatively new, and many doubts and difficulties presented themselves, more especially as I had only my own limited collection of books to refer to. These preliminary observations were intended as an introduction to the description, and treatment of the diseases incidental to seamen in warm climates. Having completed the task, although in a manner far

from satisfactory to myself,—together with an account of yellow fever, drawn up in the midst of fever patients, I was about to commence reading these observations to such of the Medical Officers as might feel disposed to attend, when I was appointed to this Hospital, without my knowledge or solicitation. This is mentioned as an act of justice to the Board of Admiralty, at the head of which Lord Melville presided, and to the present Inspector General, Sir William Burnett; and serves to shew, that no other consideration, than a presumed fitness on the part of the individual, had any influence in their selection of officers to fill important offices in the medical department. Being placed in a situation, where Lectures of a somewhat different description were required, the following observations were laid aside, without the most remote intention of publishing them.

Being in frequent communication with the Surgeons of ships commissioned at this port, and ordered to the West Indies, repeated enquiries were made respecting the treatment of the fevers on that station, and more especially by those who had never served there. My time being too much occupied to admit of explanations and discussions, with the view of disposing of the question, I have lent my manuscript, for the perusal of those who appeared desirous of obtaining information, and have been strongly urged to publish it. Being thus induced to believe that such a work might be useful, I carefully re-perused the manuscript, written fifteen years ago; and in preparing it for the Press, have found nothing to add, except two or three illustrations drawn from recent occurrences, and substituted for others. Believing, however, that “a great book is a great evil,”

I have endeavoured to condense as much as possible, by omitting all that appeared superfluous, or possessed of little interest. At a distance from London, and suspecting that the Publishers would not be disposed to pay attention to a new work on a subject, in which but little original or interesting matter was to be expected, I have had a limited number of copies printed, at my own expense and risk.

The conclusions to which I have been led, as detailed in the following pages, have been drawn from general principles, and from personal observation in every region; I therefore, trust, that I shall not be accused of uncourtesy, or a want of deference, to the opinions of others, from whom I may differ on some points. With reference to the literary execution of the work, I have aimed at nothing more than the use of language which seemed best adapted to convey my ideas clearly, and the work remains in the same form in which it was originally written.

If these outlines, therefore, induce others to think for themselves, and make more accurate and extensive observations, benefit must result to the public service; and, if in their present imperfect state, they are found to contain matter, from which the Medical, and Executive classes of Officers, can derive some practically useful hints in preserving the health of seamen, my object will have been attained.



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## CHAPTER I.

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COLOUR OF THE SKIN.—ANCIENT AND MODERN OPINIONS.—  
VARIETIES OF MEN NOT PRODUCED BY HEAT OF CLIMATE.—EFFECTS OF VARIOUS EXTERNAL AGENTS ON MAN AND ANIMALS.—LOCALITY AND MODE OF LIFE.—DETERIORATING INFLUENCES.—POWER OF ACCOMMODATION TO CIRCUMSTANCES.

ON entering into the consideration of the effects of climate upon the human constitution, we engage in an investigation involved in many difficulties ; and which does not appear to have been prosecuted with that attention, so necessary for its successful elucidation. It is true, that we have works of the greatest learning and research on the physical attributes of man, chiefly with reference to those diversities of form, features, and complexion, which are so conspicuous in the different great tribes, or families, of mankind ; and to the causes which are supposed to have operated in their production. These enquiries are of the greatest interest and importance, and have engaged the attention of philosophers in all ages. It is only in comparatively recent times, however, that anatomy and physiology have lent their aid towards the only rational mode of investigation.

If we consult the records of past ages, we find that the learned men of the two most celebrated nations of

antiquity, Greece, and Rome, speculated on the probable causes of the diversities of the human race; and have left us tolerably correct accounts of those nations whom avarice, or ambition, induced them to subject to their rule. That strict and rigorous method of inquiry, so necessary in the investigation of the laws of organic life, was scarcely recognised in the ancient schools: and fable sometimes lent her aid in attributing certain peculiarities to races of men, with whom they were but imperfectly acquainted.

The varieties of colour, however, could not fail to attract attention. The natives of Germany and Gaul, were found to have fair complexions, while, as they advanced to the south, the skin assumed a darker hue. Observing that a certain degree of darkness of the skin was produced on those parts of the body exposed to the sun's rays, it was natural to infer, that a stronger heat would produce a darker shade; and they concluded, that the burning climate of the torrid zone was alone sufficient to account for the phenomenon.

Such appears to have been the opinion in ancient times; and it is only in accordance with the general belief, that Ovid, in one of his sallies of poetic genius, ascribed the black colour of the Ethiopean to the more immediate operation of the same cause; viz., to the conflagration lighted up by Phæton in his daring adventure in the chariot of the sun.\*

In recent times, the blackness of the skin of the African, and even the peculiar cast of features, have

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\*“Sanguine tum credunt in corpora summa vocatō,  
Æthiopum populos nigrum traxisse colorem:  
Tum facta est Libye raptis humoribus æstu  
Arida.”†

† P. Ovidii Nasonis. Lib. 2. Fab. 1. Metamorphoseon. v. 235.

been attributed to the heat of the climate. As darkness of the skin, however, was not exclusively confined to the African, but found to exist among men in the coldest regions, it became necessary to modify this opinion: mode of life, extreme cold, quality of food, and various other external circumstances, were supposed to operate in the same manner as extreme heat. Although these causes undoubtedly exert a considerable influence upon the human constitution, they are quite inadequate to produce the effects attributed to them.

Some of these speculative opinions may be briefly noticed. The celebrated Buffon ascribed the colour of the skin to the action of heat, and various external circumstances: his reasoning was loose and fallacious; but the grandeur of his general views, and the imposing eloquence of his language, seemed to carry the full force of conviction. Volney adopted the same opinions, and even attempted to explain how the heat operated in producing the national features.\*

The celebrated Professor Blumenbach, whose labours have so materially contributed to illustrate the physical history of man, has given a chemical explanation of the manner in which climate acts in changing the colour of the skin. It appears that the Liver, which, according to certain modern opinions, performs such important operations in the human constitution, is the prime mover in this process. An unnatural state of the biliary secretion, produced by the agency of heat, is said to cause the vessels of the skin, by virtue of some mysterious sympathy with the liver, to secrete a superabundance of carbon, with hydrogen; and that the carbon, in some way not very clearly described, is

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\* *Voyage en Syrie et en Egypte.*

precipitated and deposited in the rete mucosum, by coming in contact with the oxygen of the atmosphere.

According to this author, the black races of mankind are afflicted with a permanent hereditary jaundice, which has become habitual ; and that they have acquired the power, not only of resisting the farther deleterious influence of the cause which originally produced it, but also the bleaching effects of more temperate climates.\*

The Rev. Dr. Smith, of America, professes to account for all the varieties which have arisen, and now exist, in the complexion, stature, and figure, of the human species, from the combined operation of three causes ; viz. climate, the state of society, and mode of life. To the operation of these causes, is attributed an influence capable of effecting the most surprising metamorphoses in the human constitution. This doctrine is supported with great confidence and ingenuity ; and the arguments adduced, may be considered as a summary of all that can be said on the subject. He also advocates the power of heat in changing the complexion, not only by its direct application, but by increasing the secretion of bile : “heat produces relaxation,”—“the bile in consequence is augmented, and shed through the whole mass of the body. This liquor changes the complexion to a yellow colour, which assumes by time a darker hue.” “Bile exposed to the sun and air, is known to change its colour to black—black, therefore, is the tropical hue.”†

Dr. Jarrold attributes the blackness of the skin to a somewhat different cause. According to this author,

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\* *De generis humani varietate nativâ.*

† *An essay on the causes of the variety of complexion and figure in the Human Species, &c. &c.*, by Samuel Stanhope Smith, D.D. &c.

light, with the assistance of moisture, constitutes a mordant, which with the presence of iron, produces the dark colour of the skin of man, animals, and vegetables.

However plausible and ingenious these arguments may be, and however great the celebrity of their authors, we cannot give assent to opinions which are contradicted by the evidence of our own senses, and by the most authentic records transmitted down through a long succession of ages. At the very commencement of the historical æra, we find allusions made to the black races of mankind. "Can the Ethiopean," says the Prophet, "change his skin, or the leopard his spots?" evidently implying, that a black skin was as natural to the one species, as a spotted one was to the other.

On a general survey of the great human family, we find five different groups, or varieties of men, each distinguished from the others by unvarying characters: viz. the Caucasian, Mongolian, Ethiopean, American, and Malay. Each of these includes several subordinate groups. The physical characters of the numerous nations occupying the central parts of Asia, appear to be the same, although they are exposed to every variety of climate and soil. In Africa, with the exception of the Barbary States, and Egypt, the same characters of a distinct race are observed among the various tribes scattered over that immense continent. The same general features, and form of the head exist, or pass into each other by insensible gradations, among the American nations, as also in the Malay and Caucasian varieties of man.

Of the causes which operated in the production of these diversities of colour and features, we are utterly ignorant, and history is silent on the subject. During

the revolution of nearly forty centuries, however, no change has taken place in the physical characters of those races, of whom we have the most accurate knowledge; and consequently, we must infer, that these peculiarities in the organization, and colour of the skin, originated in the infancy of the species, and will continue to be transmitted through all succeeding generations.

As climate, then, is incapable of effecting any permanent or material change in the colour of the skin, according to the opinions of men of the greatest learning and research, it remains to shew, how far its influence extends; and whether it be capable of producing any modification of the human constitution, in a physiological point of view.

The consideration of this important subject will necessarily require some detail; and it is only by comparing the inhabitants of different and distant parts of the world with each other, that a satisfactory solution of the question can be obtained.

Taking man as we find him, under a variety of circumstances, as climate, soil, mode of life, &c. we find that climate exerts a most material influence upon the various functions of life, and impresses modifications as varied as those diversities of colour, and features, which characterize the different races. In illustration of the extent and nature of these changes, comparative anatomy furnishes us with many striking examples.

Man, in common with other animals, is subject to the same laws which regulate the actions of life: he is nourished by the same food; breathes the same air, and acknowledges the same appetites. His superior intelligence, however, confers upon him a greater power of

obviating many injurious impressions by which he is assailed. Being naturally omnivorous, and deriving his subsistence from the animal and vegetable kingdoms, he has a greater facility of accommodating himself to the circumstances under which he is placed ; and consequently, maintains his vigour in climates where other animals deteriorate or perish. Yet, even amongst many animals, we find a power of accommodation to change of abode strikingly illustrated. When confined to certain localities, the air, the water, and the soil, conspire to maintain the functions of life in full vigour, the race acquires a uniform type, and becomes fully developed ; whilst if removed to other situations, where the same circumstances do not exist, corresponding changes take place in the constitution, which render them more fitted for their new abode. The extent of those changes is clearly seen amongst the animals which accompany us in our migrations from cold to warm climates, and vice versa. Many well known examples of this kind are alluded to by authors, a few of which it may not be superfluous to notice.

The varieties observed among our sheep and cattle, are admitted to have arisen from the situation in which they were reared : from differences in the quantity or quality of the food, in mountainous districts and on the plains. The breed of sheep in the Highlands of Scotland, and in Wales, are of a small size, with a greater length of legs, while those fed in the rich meadow lands in the low country are greatly superior in size, and shorter limbed, with a more abundant deposition of fat. The same observations equally apply to cattle, and to the horse. The sheep, when transported to the West Indies, it has been said, in a few generations,

loses his soft woolly fleece, and becomes covered with hair.\* Mr. Lawrence informs us, on the authority of Herrera, that the "European pigs conveyed in 1509 from Spain to the West Indian Island, Cubagua, degenerated into a monstrous race with toes half a span long." Those of Cuba became more than twice as large as their European progenitors."† Many other examples might be adduced to shew the influence of climate, and other external circumstances, in producing modifications in the constitutions of animals. The changes arising from local causes, merely constitute slight variations; and, while the circumstances under which they had their origin continue unchanged, are propagated in the offspring.

In man, the changes are less striking, but they are nevertheless apparent. Among individuals of the same race, we find a general resemblance in the features, as well as in the habits of thinking, and mode of expression, which constitute the national characters of different races. So powerful are the effects of external circumstances, that some of the most striking changes have been produced in the human constitution, in the course of a few generations, and become permanent. In the West Indian Islands, the white race descended from the earlier European settlers, as well as those brought from England in early life, are tall and well-proportioned, with great freedom of motion in the joints. In general, however, the chest is less capacious, and the muscles

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\* It appears that this assertion is too general; after many enquiries in the West Indies, I was informed that in the English sheep after a few generations, the wool became thinner, but in other respects was unchanged; and that this change of the fleece was only observed in the sheep originally brought from Africa, or where the breed had been crossed by them.

† Lectures on Physiology, Zoology, and the Natural History of Man, by W. Lawrence, F.R.S., P. 513.

less strongly marked. Peculiarities are also observed in the greater prominence of the bones of the cheeks, and depth of the orbits; the complexion is paler, and the skin cooler. They are temperate in their habits, and enjoy an exemption from the fevers of the country in their more severe forms. In New South Wales, the descendants of the first settlers exhibit the same peculiarities, although in a less degree.

Another striking example of the same kind is afforded in the United States of America. "The tall, lank, gaunt, and otherwise remarkable figures of the Virginians, and men of Carolina, are strikingly different from the short, plump, round faced farmers of the midland counties in England. The race is originally the same, and the deviation in it must be attributed to the influence of the circumstances, whatever they may be, which are connected with local situation." \*

The influence of warm climates is apparent after a few years residence within the tropics: Europeans lose their sanguineous complexions, and acquire the power of resisting the heat better than the new comer. This power of accommodation to circumstances, arises from a corresponding change in the functions of life; and which is usually attributed to the individual having undergone the process of seasoning;—a process of which the most vague opinions seem to be entertained. Even within the limited extent of our own country, we observe the influence of local situation, on comparing the natives of mountainous districts with those in the low country. Among the former, examples of tall individuals are less frequently met with; and in this respect,

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\* Researches into the Physical History of Mankind, by James Cowles Prichard, vol. 2nd, page 563.

man seems to bear some analogy to the sheep and cattle above alluded to. In the mountaineer, the chest will be found more expanded, and the circulation more vigorous ; the muscular system more developed, and the forms harsher. The bilious temperament prevails ; and they possess a greater quickness of temper and energy of character.

This greater developement of the respiratory apparatus, seems to result from the physical necessity of situation. In the habit of ascending and descending heights of considerable elevation, and generally breathing a more attenuated atmosphere, the organic apparatus acquires greater capacity and vigour, to enable it to afford the necessary supply of atmospherical oxygen. In level countries, on the other hand, the inhabitants are usually of taller stature : the general contour of the figure is more rounded, from the predominance of the cellular and adipose tissues. The prevailing temperament is the sanguineous. The chest, when viewed in relation to the size of the body, is less expanded ; and they are not so well adapted to undergo fatigue, when removed from their native districts. Differences of situation even impress on the constitution a disposition to particular diseases. Scrofula, and consumption, are of more frequent occurrence in the plains and agricultural districts, than in the mountainous parts of the country.

Let us observe man under other circumstances ; as in the crowded districts of a great city, or assembled in masses in our manufacturing towns. Here he is employed in occupations in which dexterity, rather than strength, is required ; and breathing an impure atmosphere, with bad lodging and bad food, the body does

not attain its full developement, and he is deficient in muscular power. This acquired constitution of body is transmitted to the offspring. His diseases are also modified by his condition ; and the constitution has not the same power of reparation in cases of injuries or disease. This permanent deterioration in the qualities of the race, has been clearly proved by their disqualification for those offices, where a certain standard of size and strength is required. It is asserted, that men from Spitalfields, and other crowded districts of London, who come forward as candidates for employment in the police force, fall short of the required standard ; and that two out of three are rejected, as physically unfit for service.

“ It is observed in some of the worst conditioned of the town districts, that the positive number of the natives of the aboriginal stock continually diminishes, and that the vacancy, as well as the increase, is made up by emigration from the healthier districts. In a late enumeration of the settled inhabitants of Westminster, it appeared that not more than one third of them were natives of London.” “ Sir James Mc Gregor, the Director General of the Army Medical Board, stated to me the fact, that “ a corps levied from the Agricultural districts in Wales, or the northern counties of England, will last longer than one recruited from the manufacturing towns, from Birmingham, Manchester, or near the metropolis. Indeed, so great and permanent is the deterioration that out of 613 men enlisted, almost all of whom came from Birmingham, and five other neighbouring towns, only 238 were approved for service.” \*

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\* Report from the Poor Law Commissioners, &c. 1842.

The power possessed by man of accommodating himself to circumstances, has not escaped the notice of the celebrated Baron Humboldt; and he is of opinion, that this power exists in the greatest perfection in the white race. It is, perhaps, difficult to determine whether this flexibility of constitution can be regarded as the peculiar attribute of the white races, as we have no means of drawing a comparison between their relative capacities in this respect. The white races alone have established colonies under the torrid and the frigid zones; and the power of maintaining themselves in these situations, seems to depend upon the superiority of their intelligence and fertility in resources, which enable them to guard against injurious impressions. The black races, on the other hand, have never voluntarily quitted their homes in search of new worlds; and, when transported across the ocean to climates similar to their own, the debasing influence of slavery was more likely to retard, than promote, the developement of the intellectual qualities of the race.

## CHAPTER II.

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MODE OF VITALITY, IN MAN AND ANIMALS, DEPENDS UPON THE CONDITION OF THE FUNCTIONS OF THE RESPIRATORY, SAN- GUIFEROUS, AND NERVOUS SYSTEMS.—ANIMAL HEAT.—POWER OF GENERATING HEAT VARIES AT DIFFERENT SEASONS; GREATEST IN COLD CLIMATES.—PHYSICAL CONDITION OF MAN IN DIFFERENT REGIONS: CORRESPONDING DIFFERENCES IN MODE OF LIFE.—INFLUENCE OF SEASONS ON DISEASE.—EFFECTS OF CHANGE OF CLIMATE ON A SHIP'S COMPANY.—CHANGES IN THE CIRCULATING FLUIDS.—ACQUIRED SUSCEPTIBILITIES.

In the preceding chapter, we have seen that climate, and various other external circumstances, are capable of producing certain modifications in the functions of life; and even of effecting slight variations in the physical qualities of the race, which become permanent, and are transmitted to the offspring. It is difficult to trace minutely the operation of these causes through their varied and complicated connexions and dependencies; yet, by observing man in the hottest and the coldest regions, and in the gradations between these extremes, we find him capable of maintaining his relation with external nature, and this power depends upon his physiological condition.

Life is an attribute belonging exclusively to organized beings, and manifests itself under conditions as

various as the organization itself; even in the same being, at different times, and under different circumstances, its manifestations are never the same. Cognizable by our senses only when in connexion with organized structure, we find it elevated or exalted, and depressed or impaired, according to the perfection, or disorder, of the organic apparatus. The amount of vitality seems to depend upon the energy with which the nervous and sanguiferous systems perform their functions. When under the influence of wine, or other stimulants, the heart acts with increased force and frequency; a greater quantity of blood is propelled into the capillaries; the face is flushed, and there is a greater production of animal heat, as indicated by the general glow of warmth which pervades the surface of the body.

“The evolution of heat,” says Bichat, “is always subordinate to the state of the vital power. According as the tone is languid or exalted in a part, this part possesses more or less heat.”\* The intimacy of the connexion between the nervous and vascular systems, is strikingly displayed by the effects of moral emotions. In the blush of shame, the blood is instantly propelled to the capillaries, by one of those fine sympathies which appears to subsist between the mental and physical parts of our nature, communicating a crimson suffusion to the face and neck, and often as transient as the cause from which it originated. Under the depressing influence of grief, fear, or exhaustion, the circulation is languid, and the power of producing heat diminished. A similar physiological state of the system exists to a certain extent, during sleep; the voluntary motions are suspended; the nervous system remains in a state of quiescence, or

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\* *Anatomie Générale*, Par Xavier Bichat, Tome 2. a Paris, 1818, p. 49.

repose; the circulation and respiration become slower; less oxygen is consumed, and consequently less heat is generated.

It is in the capillary system that these processes are carried on, and the extent of this system is immense. "It embraces," says Bichat, "the most minute divisions of our parts, so that we can scarcely conceive any organic particles united without these capillaries. From hence it follows, that this system is not only intermediate to the arteries and the veins—that it is from it that the organs of exhalation, excretion, &c. take their origin."

"It is in this system that the vessels arise which carry to all our organs the materials of nutrition: it exists in all parts where the arteries do not penetrate, as well as in those to which they extend." He maintains that the heat of animal bodies is generated in the capillary system, free caloric being given off, as the blood passes from arterial to venous, and by the changes produced in this fluid by secretion, &c.\* "Caloric reaches the capillary system in combination with the materials for secretion, with those for exhalation and nutrition. The blood is the common fluid which results from all these combinations. In the general capillary system, each part is separated; the caloric to be diffused throughout the body, and be afterwards emitted; the fluids for the secretions to flow through the glands; those for exhalation to escape through their respective surfaces; the materials for nutrition to remain in the organs."

As the human body is composed of an assemblage of organs, each destined for the performance of its own proper function, and to maintain those relations on

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\* Ibidem, p. 7. Ibidem, p. 48.

which the welfare of the whole depends; it is obvious, that a limited or partial view of any individual function, or particular structure, is not calculated to add much to our knowledge of the nature of those actions which constitute either health or disease. We must regard them as parts of one whole, governed by the same general laws, but each possessed of an organization, and degree of sensibility, adapted to the end it has to fulfil; each excited into action by its own proper stimulus, and modified in those deviations to which we apply the term, disease.

The power of producing heat is inseparably connected with the circulation, and the nervous system; and the greater the energy with which these functions are performed, the greater will be this power. One of the most important conditions appears to be an expanded lung, and of this, comparative anatomy affords the most striking proofs. In birds, especially birds of prey, by a peculiarity in their anatomical structure, the respiratory organ is greatly extended. The pulse is quicker, and the heat of their bodies is six or seven degrees above that of man. In their various motions when on the wing, they display a greater degree of muscular power than any other animal.

In the carnivorous tribe of animals, the lung is ample, and the circulation more rapid. In the dog and cat, the pulse is quicker, and the heat of the body greater, than in man; and they possess a higher power of reparation in cases of wounds and injuries. In a compound fracture of the thigh bone of a cat, with protrusion of the ends of the bone through the integuments, firm bony union was found to have taken place on the twenty-first, and exfoliation of a projecting

portion was completed on the twenty-eighth day, without any assistance from art.

In graminivorous animals, the lung is less expanded, in proportion to the size of the body: their food is less stimulating, and the circulation is slower. In the horse, the pulse is about forty-five in the minute, and the power of the constitution in repairing injuries is more feeble; fractured bones unite with difficulty; ulcers require powerfully stimulating applications, to exalt the vitality of the part, and promote cicatrisation.

Among the lower tribes of animals, as reptiles, where the temperature of their bodies is often lower than that of the atmosphere, the respiratory apparatus is still more contracted; and from the slowness of their respiration, a smaller quantity of oxygen is presented to the extreme branches of the pulmonary artery: the pulse is slow in proportion, and wounds with difficulty heal. In a large species of lizard (*Lacerta Iguana*) the number of respirations, after many observations, was found to be about seventeen, and the pulsations of the artery in the axilla, about twenty-two per minute. A wound in the muscular part of the thigh, inflicted by a cutlass in digging the animal out of his hole, shewed no disposition to heal. At the end of three weeks, although the animal was well fed, the wound presented the same raw appearance as when first inflicted. At the end of seven weeks, it had not diminished in size, but something like incipient cicatrisation appeared around the margin. Many other analogies might be adduced to shew, that the energy of the functions of life has an intimate relation to the quantity of oxygen consumed by respiration. The justly celebrated Baron Cuvier observes, "L'histoire des rapports qu'on observe

dans les divers animaux, entre les quantites de leur respiration, et l'énergie des leur forces motrices, est une des plus belles démonstrations que l'anatomie comparée puisse fournir à une théorie physiologique.”\*

The state of the blood, however, or of the vessels through which it flows, even if perfectly understood, would not enable us to account for all the phenomena. The nerves perform an important part in these processes. “Mr. Brodie, in the Croonian Lecture for 1810, gave an account of experiments which led to the inference, that the production of animal temperature is under the influence of the nervous system: and in the Philosophical Transactions of 1812, he relates additional experiments tending to strengthen this inference.” Dr. Philip observes “the various phenomena of animal temperature, and the experiments on this subject, related in the last chapter, compared with effects on secreting surfaces, observed in these experiments, seem to me to prove, that the caloric, which supports animal temperature, is evolved by the same means; namely, the action of the nervous influence on the blood, by which the secreted fluids is effected, and consequently that it is to be regarded as a secretion.”†

It is perhaps impossible to prove the truth of this assertion, as we cannot perform experiments on these systems in an insulated state during life. The nerves are abundantly supplied with blood, and healthy action is the result of the united co-operation of the whole. It would appear, therefore, that animal heat results from a process somewhat analogous to chemical action, and

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\* *Leçons D'anatomie comparée* De G. Cuvier, Paris, 1805, tome 4, p. 301.

† *An experimental enquiry into the laws of the vital functions, &c. by A. P. Wilson Philip, M.D., F.R.S., &c. London, 1818. part 2, chap. 8.*

is increased in quantity according to the energy of the nervous, vascular, and secreting systems. As far as I am acquainted, it has not been determined by experiment, whether the conversion of a part of the blood in the capillary system into new products, is attended by the evolution of electricity, or of sensible caloric, as we find in other cases of chemical action. It has been urged, as an objection to the theory of Dr. Crawford, that the heat produced by the combination of the oxygen with the blood, and evolved in a sensible state, as the blood is gradually changing into venous, falls short of the quantity actually generated. It is, therefore, more than probable, that in addition to that developed in the course of the circulation, and in the lungs, by the inferior capacity of carbonic acid for latent heat, sensible heat is generated by the process of secretion, in the glandular and capillary systems. But even if this difficulty was explained, it would not enable us to understand the nature of that mysterious power, which presides over the involuntary motions, and regulates the various and complicated phenomena of life.

On a comparison of the habits and mode of life of man, in the torrid and frigid zones, it is evident that the functions of life cannot be performed in the same manner in these opposite extremes. The existence of some modification of vital action had been long suspected, and the strongest analogies led to the conclusion, that this depended upon corresponding variations in the power of generating animal heat. For actual proofs, however, we are indebted to Dr. Edwards of Paris, who, by a series of the most accurate experiments upon animals placed under a variety of circumstances, proved, that a greater quantity of heat is produced during

winter than summer ; and that important changes take place in the constitution during these periods of the year. He also pointed out the curious peculiarities in the young of certain animals, with reference to this process. These interesting facts admit of the most important and extensive practical applications, in explaining the effects of changes of climate in our various migrations, and also in pointing out the means of obviating their deleterious influence.\*

In cold countries, the subtraction of the heat of the body by surrounding media, is infinitely greater than under a tropical sun ; and it is absolutely necessary for the preservation of the species, that some modification of vital action should exist, to enable man to maintain his relation with external nature. In the maintenance of this physiological condition, or mode of vitality, the quality and quantity of the food will be found to depend upon the physical necessities of the individual, or the calls made upon the system. The mode of life, and habits of the natives of different regions, afford ample proofs of this most important influence. In cold climates, a greater quantity of animal food is required than in warm countries, and there is a greater desire for stimulating drinks. The native of the hyperborean regions, where the rigour of the climate prevents the cultivation of the farinaceous seeds, subsists exclusively on animal food, and that of the coarsest kind. His diet consists of the flesh, and oil of whales, seals, bears, and fish : the skins of the same animals furnish him with clothing ; yet he continues his species, and the race does not appear to degenerate.

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\* De L' influence des Agens Physiques sur la vie Par W. F. Edwards, D.M., Paris, 1824.

In this state of existence, the mind is not occupied in devising schemes of ideal happiness ; all its energies are directed to the provision of a sufficient supply of food to last through his long night, and in this he displays considerable address. His purely animal diet consists almost entirely of nutritive matter, and requires a vigorous action of the digestive organs for its elaboration. Hence, we may infer, from actual observation, and from the analogies afforded by the carnivorous tribes of animals, that a greater quantity of oxygen is absorbed into the blood ; and consequently, that there is a greater production of animal heat, to compensate for the greater subtraction by surrounding media. The Esquimaux Indian, and the Greenlander, when brought to this country, suffer much from the heat of our summer and autumn. The associated trains of action established in the animal economy, under a certain combination of circumstances, cannot be immediately arrested : the heat generated is greater than the wants of the system require in its new abode ; or, in other words, the quantity abstracted is less, and plethora is the consequence. In this respect, the Greenlander is in the same situation as the European, when transported in a few weeks to a tropical climate.

In the temperate zone, where the earth is cultivated, and social institutions exist, the food is mixed with a considerable proportion of vegetable matter. Where man lives in societies, and where the gratification of his wants implies a certain degree of mental and bodily labour, we might expect to find his intellectual and physical qualities in the greatest perfection : accordingly, it is in countries within the temperate zone, that civilization has advanced with the most rapid strides.

In these regions, man is removed from the extremes of heat and cold, yet the changes of seasons are accompanied with corresponding modifications of vital action, which constitute, as it were, a series of oscillations from a fixed point, and tending, by their alternate succession within certain limits, to invigorate the system and call forth its full powers.

In warm climates, the proportion of animal food is still farther diminished ; and in the East Indies, a large portion of the inhabitants subsist chiefly on a vegetable diet. The heat of their climate renders stimulating food and drink unnecessary and injurious, and with them, temperance can scarcely be considered as a virtue. In the West Indies, the black and brown races are temperate in their habits, and do not indulge in animal food. A little salt meat, or fish, is used to give a relish to their plantains, yams, and other vegetable productions : spices are also freely used, and seem to communicate a tone to the digestive organs, unaccompanied by the stimulating effects of wine or spirits. Although Rum is cheap in all the Islands, an instance of intoxication among the negroes is seldom met with.

This disrelish for stimulating food or drink, has no reference to the difficulty or facility of procuring them : it proceeds from an instinctive feeling, that the wants of the system do not require such stimulating substances ; and any unusual indulgence of the kind is found to produce unpleasant sensations, and prove injurious to health. This temperance in the habits of the natives of warm climates, and the smaller quantity of animal food consumed, is attended by a less energetic action of the functions of life.

Although we meet with the finest and most muscular forms amongst them, they are inferior to the Europeans in point of physical strength. This is most clearly observed, when a party of natives are employed at the same time with Europeans. On many occasions, when a working party of seamen and marines were employed in the Dock Yard at Jamaica, in landing stores, &c., one white man would perform twice as much work as a negro, or man of colour, who were employed as labourers. With their native energy of character, the former would roll heavy casks, or lift weights, which more than double the number of natives could not effect: the face would be flushed, the skin covered with perspiration, and a full and bounding pulse upwards of 100. In the black and brown men, although exerting themselves, the skin would be cool, and the pulse not exceeding 80, and less expanded. In their intervals of rest, the pulse was repeatedly examined in twenty or thirty black and brown men, and the same number of seamen and marines, and in the former, it was invariably slower and weaker.

This peculiarity of constitution exempts them from those severe forms of fever, which often prove so fatal. When attacked with fever, it appears in the mild remittent, or intermittent form. In cases of injuries, or disease, they could not bear bleeding to any extent. The loss of eight or ten ounces of blood, was found to produce as great an effect as double the quantity on a European, and they required smaller doses of medicine. It must be observed, however, that black men, who were not natives of the West Indies, were under very different circumstances. A few blacks, and men of colour, were occasionally found serving in our ships-of-war, who were natives of the British Colonies in North

America. Born and reared in a country where the cold is severe during the winter, they had acquired the constitution of Europeans: some of those men who were attacked with fever, bore evacuations as well as Europeans; and after many inquiries, it appeared, that in point of energy and physical strength, they were upon an equality with their shipmates.

Having now seen the mutual connexion which exists between the effects of climate, food, mode of life, &c., and the state of the animal functions in different races of men, we may briefly notice the influence of the seasons in our own country; and the changes produced in the system by sudden migration, with reference to the production of disease. It has been shewn, that the quantity of animal heat generated is less in summer than in winter; and that this is the result of a less energetic action of the vital processes, but which is in relation with external circumstances. A certain physiological condition being established, it is some time before a change takes place in the constitution; more especially in persons advanced in years, or when the powers of life are feeble. On the approach of winter, they with difficulty maintain the heat of the body, and suffer from coldness of the extremities. As the winter advances, they feel the necessity of artificial warmth; and with proper care, if no organic disease exists, the constitution gradually accommodates itself to the change, and acquires an increased power of generating heat. On the approach of summer, an increase of life and activity pervades the whole animal kingdom.\*

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\* Omne adeò genus in terris hominumque ferarumque,  
Et genus cœquorum, pecudes, pictæque volueres,  
In furias ignemque ruunt: amor omnibus idem.†

† P. Virgilii Maronis Georgica, Lib. 3, ver. 241.

The winter constitution being now formed, and the subtraction of heat diminished, from the increased temperature of the atmosphere, the functions of life are too energetic for this new change of condition ; hence we can understand the cause of the differences observed in the characters of disease in spring and autumn. In the latter season, fevers of the remittent and intermittent type, and disorders of the alimentary canal and chylo-poietic viscera, prevail : while, in the spring, diseases are of a more inflammatory character, and marked by a greater degree of excitement of the nervous and sanguiferous systems.

These different states of the constitution have been recognized from the most ancient times ; and it has long been a prevalent opinion, that in the spring of the year, the blood is richer than at other seasons, for which bloodletting and evacuations are considered the appropriate remedies. Hippocrates describes these states of the constitution with great accuracy,—also the diseases that prevail at particular seasons—the influence of atmospherical vicissitudes—and lays down rules for the regulation of the diet, in different ages and constitutions, which are strictly in accordance with the opinions of the present day.\*

Sydenham appears to have been fully aware of the influence of the seasons, in modifying the character of diseases. In treating of autumnal intermittents he says. “I judge that these intermittents are occasioned nearly in the following manner ; viz., as the year advances the blood is likewise proportionally enriched, (just as vegetables show the course of the year by their growth and decay) till it comes to its height, and

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\* Hippocratis Opera, Sec. 4. Περὶ διαίτης ἴγκενης

ultimate vigour, after which, keeping pace with the time of the year, upon the declension thereof, it also declines; and more particularly when some accidental cause contributes thereto, as great loss of blood, taking cold, the use of indigestible and excrementitious food, and unseasonable bathing, and the like. For the blood, being in this depressed state, is subject to every morbific impression that any constitution of the air may communicate to it, which, at this time, tends to produce intermittents epidemically.”\*

In the naval service, we have frequent opportunities of observing the effects of climate on a ship’s company proceeding to a foreign station; and for the sake of illustration, it may not be superfluous to take a general view of the change of circumstances they encounter. On a ship of war being commissioned, it is an object to complete the complement of seamen as soon as possible. Large ships are frequently commissioned in the autumn, or winter, as seamen are then more easily obtained, from the circumstance of the merchant vessels, employed in the North American and Baltic trades, being laid up at that season of the year. At other times, a ship is put in commission on the eve of another being paid off, and if the captain be a popular man, he is certain of procuring a number of prime seamen who are attached to the service.

There is always a certain number of men who have been lately discharged from the Hospital, and are borne on the books of the Flag Ship for general service. Others, again, have been leading a life of dissipation on shore, and when they have spent their money, re-enter

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\* The Works of Thomas Sydenham, M.D., by George Wallis, M.D., vol. 1. p. 85.

the service. When seamen are scarce, a rendezvous is established at one or two of the large seaport towns for the reception of volunteers, who from time to time are sent to the ship in the tender; and many of them without a bed or blanket, and badly supplied with clothing. Many of these recruits are labourers, young men, too indolent to work, or bad characters, tradesmen out of employment, &c. These men are perfectly unacquainted with a ship, but provided they are young men, and free from complaint or bodily infirmity, are admitted into the service, and after a little training, become useful men. At the end of six weeks, or two months, there is an assemblage of men of all descriptions, of different habits and constitutional susceptibilities. While the equipment of the ship is going on, they live on board of a hulk, and are employed in working parties at the Dock-yard, putting on board the various stores, rigging the ship, and other duties, and are often exposed to the weather. Their sleep, however, is not disturbed at night by keeping watch; their diet is of the best and most nutritious quality, and the appearance of the ship's company soon undergoes a most decided improvement.

The diseases which prevail at this period are referrible to exposure to the weather, and consist of catarrhs, febrile, and rheumatic attacks, and always a considerable number of syphilitic cases. Among the new raised men, many of whom had been living on scanty fare, disease can be often traced to repletion. The marines, who embark on the ship's being commissioned, are invariably in a higher state of health than the seamen; and this is to be attributed to their being always on service when

ashore in their barracks; and to the strict order and regularity maintained amongst them.

As the fitting of the ship proceeds, the sick are sent to the Hospital; and men who are unfit for the service, are invalidated and discharged. By the time the ship is ready for sea, we have an assemblage of six or seven hundred men under the same circumstances, as far as diet, clothing, and mode of life, are concerned. The great majority are young men in the vigour of life, and their labour is light. Under these circumstances, the standard of health is high; and were the ship employed on the home station, in all probability, the ratio of mortality would be less than among the same number of the labouring classes. On proceeding to sea, there is a complete change in the habits of the ship's company. They are placed upon salt provisions; their sleep is disturbed by the alternation of the watches; and, if exposed to tempestuous weather in the Channel and Bay of Biscay, they are subject to inflammatory attacks.

Let us suppose the West Indies to be the destination of the ship. With a fair wind, they are carried within the tropics in fourteen days. In this short period, they experience a change of temperature of  $30^{\circ}$ , or  $40^{\circ}$ , Fahrt. In this sudden transition from an English winter to a warm climate, the subtraction of animal heat is less, while the diet and drink continue the same, and maintain the vital processes in full energy. Under these circumstances, it is evident that changes must take place in the quality of the circulating fluids, which, although it may be difficult to trace through their various connexions and dependencies, give rise to that

particular state of constitution, to which the term, inflammatory diathesis, is commonly applied.

On approaching the warmer latitudes, the looks of sailors improve: as the ship glides along before the North East trade wind, under a clear and blue tropical sky, days often pass without a sail requiring to be shifted. The temper of the ship's company becomes more cheerful—a greater degree of alacrity is observed in their movements,—the skin becomes softer, elastic, and more vascular, with an increase of perspiration,—and they enjoy a superabundance of health, if the phrase may be allowed. In some cases of indisposition, so slight as scarcely to deserve notice, a few ounces of blood have been repeatedly drawn as an experiment. It exhibited, on every occasion, the buffy coat, as we find in other cases of excitement. The crassamentum was firm, and evidently contained a larger proportion of fibrine than usual.

According to an established law in the animal economy, when one organ, or set of organs, are in a state of excitement, there is a corresponding inactivity in some other: so, in the present case, the stomach and alimentary canal sympathise, and are unable to assimilate for the purpose of nutrition, the same quantity of aliment. This, indeed, is productive of the most salutary effects, and appears to be a wise provision of nature to obviate plethora. The functions of the liver appear to deviate from the usual healthy state, and indications may be observed of a derangement of the secretions in general: so trifling, however, are these deviations from the ordinary state of health, that a complaint is seldom made. Constipation, however, appears to be of frequent occurrence, from the number of applications for aperient

medicines, of which experience has taught them the utility. It is also a common practice with seamen, on entering a warm climate, to take a draught of salt water early in the morning occasionally. If disease does appear, it is generally in the form of fever, with high vascular excitement, and determination of blood to the head. Boils are of frequent occurrence, and also prickly heat, which, to a certain extent, are salutary, by tending to relieve the plethora state of the system.

Supposing the East Indies to be the destination of the ship, they pursue their course to the southward, and stretch towards the South American continent. On getting beyond the limits of the South East trade, they steer to the South East, and run into the latitude of  $36^{\circ}$  or  $38^{\circ}$  South, where strong westerly winds are found to prevail. In fourteen days, or three weeks, they are again wafted into a cold climate, where the temperature of the air is from  $36^{\circ}$  to  $40^{\circ}$  Faht., and sometimes at the freezing point. The ship continues on this parallel, across the Southern ocean, for a distance of three or four thousand miles. During this run, nothing is seen to divert the mind; and the countenances of the persons embarked will be found to have undergone a change, and assumed a certain haggard expression. If examined closely, the gums will be seen to have lost their natural red hue, appear shrivelled, and present a whiteness around the roots of the teeth.

The diseases which now appear, especially if the weather prove wet and cold, are Pneumonia, Rheumatic attacks, Catarrhs, and Diarrhoea: the accompanying fever is of the low nervous type. In some cases of slight indisposition, a few ounces of blood were drawn from the arm, rather by way of experiment than from neces-

sity; and it was found to be less florid, and slower in coagulating, than within the tropics; the crassamentum was easily broken down between the fingers, and evidently contained a smaller proportion of fibrine, or coagulable lymph. This was observed in seven convicts under thirty years of age, and three soldiers, out of a party of forty, embarked as a guard. The former, although prisoners, were allowed to come on deck before the mainmast when they pleased, and occasionally assisted in working the ship of their own accord. The soldiers did duty as a guard, and were on full rations; while the convicts were upon two thirds, or six men had the allowance of four seamen, but they had many comforts in addition. In this respect, the convict is better provided than a soldier embarked on board a Transport, and proceeding on service. Being considered in the light of a passenger, and having no active duties to perform, he is placed upon the ration of two thirds. The health of the persons embarked, 285 in number, continued good, and no death occurred during the voyage.

The effects of a sudden change, from a cold to a hot climate, upon the European constitution, have been already detailed in the preceding pages. On reaching the higher southern latitudes they may be considered, to a certain extent, in the same situation as the native of a cold climate after a warm summer. The functions of life are performed with less energy, and the supply of animal heat is diminished. On suddenly entering a colder climate, the reduction of a few degrees in the temperature of the air is most sensibly felt. The system taken by surprise, as it were, is suddenly called upon to make an effort; but as new trains of action have

been already partially established, the constitution cannot immediately accommodate itself to the sudden change of circumstances. If India be the place of destination, on reaching the 70th or 80th degree of East Longitude, they direct their course to the North, and soon get into the S. E. trade wind, which carries them into the Bay of Bengal. Thus, in the short space of three or four months, the ship's company have experienced two summers and two winters.

Although actual disease may not have appeared during these rapid and extreme changes of climate, it cannot be doubted, that a certain excitability of constitution is generated, which renders the body more susceptible of impression from the ordinary exciting causes of disease.

## CHAPTER III.

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EXHALATIONS FROM THE SOIL OF MARSHY DISTRICTS.—GENERAL BELIEF IN MALARIA.—OPINIONS ON THE NATURE AND ORIGIN OF MALARIA.—PROPERTIES AND EFFECTS OF MALARIA.—FEVERS OCCUR WHERE SWAMPS DO NOT EXIST.—SWAMPY DISTRICTS SOMETIMES THE MOST HEALTHY.—ANALYSIS OF THE AIR OF SWAMPY SOILS.—MALARIA NOT DETECTED IN SWAMPS OF BATAVIA, NOR IN THE PALLISADES AT PORT ROYAL.—VEGETABLE PRINCIPLE.—DECOMPOSITION OF TIMBER.—NOXIOUS GASES IN THE HOLDS OF SHIPS.—SULPHURETTED HYDROGEN.—EARTHY ODOUR IN WARM CLIMATES.—PEAT BOGS.—MANGROVE SWAMPS.—CHEMICAL DECOMPOSITION AND REPRODUCTION.—ORIGIN OF FOGS AND DEW.—NATURE OF MIASMATA NOT KNOWN.—EXISTENCE OF MIASMATA AN ASSUMPTION.

THE causes which operate in the production of endemic and epidemic diseases, have, in all ages, afforded an interesting object of research to medical philosophers ; yet, it must be confessed, that their efforts have not been attended with much success, either in determining the nature, or obviating the effects, of these supposed causes. We have accounts transmitted from the earliest times, of the occasional prevalence of pestilential diseases, which committed dreadful ravages in fleets and armies, and spread through extensive districts ; and, as no very obvious cause could be assigned for these mysterious visitations, they were attributed to certain conditions of the soil, the weather, and the water.

Hippocrates has left us most circumstantial accounts of the effects of locality, both on health and disease. He gives a most accurate description of the qualities of the water, and the air, in marshy situations, and their effects in the production of particular diseases: and, with all our experience, and greater knowledge of the collateral sciences, it may be fairly questioned, whether we have acquired any additional information.\*

In more recent times, indeed, it has been assumed, that the influence of these causes has been more correctly ascertained; and from the prevalence of certain diseases in particular districts, emanations from the soil are supposed to have imparted noxious qualities to the atmosphere. With regard to the nature of these exhalations, nothing seems to be known, but the fact of their existence and activity, is almost universally admitted. Experience, however, is sometimes fallacious; and other opinions, apparently as firmly established, as a belief in the existence of Marsh Miasmata, have been proved to be unfounded. The existence of these exhalations from the soil, has been admitted by almost all medical writers in modern times; and, after examining the grounds of this belief, it may not be superfluous to inquire, whether other causes of a different description, may not have proved equally active in their operation.

The doctrine of vegeto-animal effluvia, comes into action in naval and military operations—in selecting anchorages for ships, and in the construction of temporary or permanent encampments for troops, &c. The medical officers are, it is presumed, generally consulted on these occasions; and if they betray an ignorance of

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\* Hippocratis Opera. Anutio Fæsio Geneva. Tom 1. Sec. 3.

*Περὶ ἀέρων, ὕδατων, τόπων*

the circumstances likely to affect, either directly or indirectly, the health of the men committed to their care, their professional character is apt to suffer.

By many of the earlier writers on the diseases of warm climates, frequent allusion is made to Marsh Miasmata ; one or two of which may be quoted.

Prosper Alpinus, who practised in Egypt from 1580, to 1584, speaking of the pestilential fever of Alexandria, states, that various opinions are entertained by physicians respecting the cause. By some, it was attributed to putrid exhalations arising from the lake of Mareotis, which were conveyed to the city by the winds. By others, to putrid and poisonous exhalations mingling with the air, and arising from putrid and bad water contained in reservoirs under the city, which were filled during the overflowing of the Nile, to afford a supply of water to the inhabitants throughout the year.\*

Bontius, who practised for several years at Batavia, to 1631, describing the state of the air, says, "it is rendered insalubrious, not only from its heat and moisture, —the promoters of putridity,—but also by the stagnant and marshy places with which the country abounds ; and that the wind, blowing from the mountains, brings to the city from these marshes, dense, fetid, and poisonous exhalations, which corrupt the air." He continues, "these land winds ought to be carefully avoided, and especially after cock-crow in the morning watch, when the body is in a state of perspiration and the pores of the skin open, as their subtle and penetrating qualities then produce the most injurious effects."†

During the prevalence of those epidemics, which

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\* Prosperi Alpini, *de Medicina Ægyptiorum*, Lib. 1, cap. 14.

† Jacobi Bontii, *de Medicina Indorum*, *Dialogus 1.*

committed such ravages in our own country in the time of Sydenham, that truly eminent man was led to attribute the diseases in question “to a certain secret disposition of the air” produced by “a certain secret and inexplicable alteration in the bowels of the earth, whence the air becomes impregnated with such kinds of effluvia, as subject the human body to particular distempers, so long as that kind of constitution prevails, which, after a certain course of years, declines and gives way to another.”\* He acknowledges that he had made no progress in ascertaining the qualities of the air; and his conclusions seem to have been drawn, rather from a preconceived opinion that some change had taken place, than from any actual proof of its existence. Although several Authors prior to Sydenham, had observed and mentioned the insalubrity of marshy districts, he does not appear to have had any knowledge or suspicion, of the existence of Malaria proceeding from these sources, and operating as the cause of Intermittent fevers: and even when he attempts to assign reasons for the prevalence of epidemic intermittents in autumn, he seems to be of opinion, that the true cause was a change in the state of the blood, dependent on the change of the season.†

About the middle of last century, Lancisi was led to believe, that emanations from the soil of swampy districts, produced powerful effects upon the human body; and by many observations, was convinced that Intermittent fevers owed their origin to this cause. He has, therefore, generally been considered the discoverer of

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\* The Works of Thomas Sydenham, M.D., by George Wallis, M.D., page 8, vol. 1.

† Ibidem, page 85.

Marsh Miasmata. Human effluvia, and contagion, were already recognized as the cause of a numerous class of diseases, with, or without, remissions. The discovery of a new agent, therefore, in the production of Intermittents, was hailed as a most important addition to our knowledge: it was considered conformable to the order of nature, and like the Phlogiston of the Chemists, was universal in its application, and explained all difficulties.

If we look through the works of the most distinguished medical writers during nearly a century, the existence of this invisible agent does not appear ever to have been questioned; and perhaps, there is no subject in medicine, on which so great an unanimity prevails, as on the existence of Marsh Miasmata. For proofs of the operation of this poison on the human body, we have only to consult the works of a variety of authors; and more especially those on the diseases incidental to Europeans in warm climates, and written by medical officers in the public service. Sir John Pringle gives an instance of the effects produced by draining the water from a district in Holland, which had been inundated for military purposes.\*

Drs. Trotter, Clarke, Johnson, and others, give many examples of fever having been contracted by boats' crews, from sleeping on shore during the night. From the great prevalence of disease, and mortality among our troops at Walcheren, we have the strongest and most melancholy evidence of the existence of some cause, and this cause was attributed to exhalations from the soil. In all these cases, however, various other circumstances, likely to produce powerful impressions, passed unnoticed. These all powerful Marsh Miasmata were

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\* Observations on the diseases of the Army, by Sir John Pringle.

alone considered sufficient, and superseded the necessity of further inquiry. Pursuing this one-sided view of the case, we can readily account for the cause of the sickness and mortality among our seamen on the coast of Africa; and more especially, among the boats' crews employed in the rivers in search of slave vessels. It is unnecessary to multiply examples, yet one or two may be mentioned, out of several of the same description, which fell under my own observation at Batavia; and which, regarded in an insulated point of view, might be considered as convincing proofs of the existence of Miasmata.

One afternoon, when going off to the ship in which I was proceeding as a passenger to England, two of the boat's crew had strolled into the town, and could not be found. As there was another boat on shore, the coxswain was desired to look after them, and I sailed off before the land breeze which was just commencing. In the course of the evening they became intoxicated and riotous, and were lodged in a damp apartment on the ground floor by the Dutch guard. This guard house was situated at the junction of three rivers, or canals, and was considered one of the most unhealthy spots in the country. The Dutch sentries were relieved every hour, and, while they remained at their posts, were allowed cigars by Government, from an idea, that the smoke of tobacco had the effect of destroying the noxious exhalations, that were supposed to arise from the soil. The following day, the two men were sent off to the ship. In the evening, about ten hours after they left their place of confinement, one was attacked with fever in the most concentrated form, and died after fifty-two hours illness. The other was attacked the second

evening, with the same form of fever, and had a very narrow escape. Nine men belonging to other ships, were confined in the same place at different times, and under similar circumstances ; seven of whom had an attack of fever within four days, and three died. It must be observed, however, that fever was prevailing at the time, on board the ships to which they belonged.

With reference to the nature and composition of this *vegeto-animal* poison, it may be remarked, that the mode of inquiry pursued has been different from that adopted in all other cases. In all cases of chemical analysis, it is an essential preliminary, that the substance to be submitted to examination should first be procured ; and its physical properties, as weight, taste, smell, colour, &c., ascertained. Of the existence of this poison we have no positive proofs : it has never been obtained in an insulated state ; and consequently we are totally ignorant of its physical qualities. Air from situations where this invisible material was supposed to abound, has been submitted to the most careful chemical analysis, and found not to differ in its chemical composition from common air. Gazeous fluids, with which the atmosphere may be accidentally mixed, can be readily detected by the appropriate tests, and their relative proportions accurately ascertained. This poison, however, has hitherto eluded the researches of the Chemist, and is known by its alleged effects only.

If we examine the works of Authors, who may be supposed to be best acquainted with the subject, we shall find that the greatest diversity of opinion prevails. By some, it is supposed to extend its influence but a short distance from its source, and that it is disarmed of its virulence by being diffused through the air. According to others,

it shuns the light of day ; but as soon as the shades of darkness close around, it comes forth from its hiding place,—is borne on the wings of the wind to a distance of several miles, and like certain beasts of prey, attacks its victims only by night. Others assert, that it is disengaged from every variety of soil. In one case, air, heat, moisture, and the putrefying remains of animals and vegetables, are essential. In other cases, it is produced in situations where swamps do not exist, and where there are no animal or vegetable matters.

According to some, it is possessed of greater specific gravity than the atmosphere, and has a great affinity for the earth ; that it attaches itself to trees and shrubs, which arrest its progress ; and that it ascends the sides of hills, contrary to the laws of gravity. According to a late author, this fair world of ours is the hot bed of pestilence and death: every shrub, every meadow, every isolated tuft of coarse grass in an extensive sandy plain, pours forth in abundance this mysterious poison, which is somewhat poetically characterized as “the destroying angel, the real pestilence which walks at noon day ; and to which all other causes of mortality are but as feeble auxiliaries in the work of destruction.”\* In the neighbourhood of Rome, it is asserted that this poison attaches itself to plants ; and that if a certain species of thistle is cut down, it will be disengaged and produce fever. An American author has gone a step farther, and divided these exhalations into orders, genera, and species. We are informed that Perkino-miasma, the second species of the Genus, Kino-miasma, Order 2nd, Infection, produces yellow fever and plague. As

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\* Malaria ; an Essay on the production and propagation of this poison, &c., by John Macculloch, M.D., F.R.S., &c.

these two diseases are essentially different in their nature and symptoms, it is obvious, that the principles upon which such an arrangement is founded must be erroneous.\*

Equally extraordinary, and almost incredible, accounts are given of the limited extent to which these exhalations are confined. Lancisi gives several instances of the prevalence of marsh fever in particular parts of Rome, while others in the immediate vicinity remained perfectly healthy. Dr. Bancroft quotes several examples of the same description.†

Sir Gilbert Blane, who was sent to Walcheren in 1809, to inquire into the cause of sickness, informs us that during the thirteen days he remained there, he had “an opportunity of observing the extent to which the noxious exhalations extended, which was found to be less than is, I believe, generally known. Not only the crews of the ships in the road of Flushing were entirely free from this endemic, but also the guard ships, which were stationed in the narrow channel between this island and Beveland. The width of this channel is about 6,000 feet: yet though some of the ships lay much nearer to one shore than the other, there was no instance of any of the men or officers being taken ill with the same disorder, as that with which the troops

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\* Elements of the Etiology and Philosophy of Epidemics, by Joseph Mather Smith, M.D., &c., New York, 1824.

† An Essay on the disease called Yellow Fever, by E. N. Bancroft.

When I had the pleasure of his acquaintance in Jamaica, in 1827, 8, and 9, he was in practice as a Physician at Kingston, and his opinions on the subject of Marsh Miasmata had undergone a change. I detailed to him certain experiments I had performed, and he stated more than once, that he had spent many of the best years of his life in the West Indies, and was now more doubtful than ever, whether any injurious exhalations arose from the soil; but he added, we cannot dispense with them, until you find something better to substitute.

on shore were affected.”\* This was considered as a decisive proof, that the action of the noxious exhalations was nearly confined to their source.

Another author of equal character, and probably of much greater experience, acquired during a long residence in warm climates, maintains that these exhalations extend their influence to a distance of several miles. Dr. Jackson says, “the exhalation which is supposed to be the material cause of fever, is not visible to the acutest sight, so as to be traced by the eye; but, as judged by effect, it appears to be capable of being wafted, in the common atmosphere, to the distance of several miles; and it appears moreover to acquire force from the impetus with which it strikes the subject.”† We have details given by other writers, of the effects of these effluvia upon the crews of ships anchored under the lee of swampy land, and at a distance of several miles. It appears also, that they acquire new properties in their passage, or that different kinds of Miasmata are generated; as, instead of producing fever, they give rise to Cholera, Dysentery, or Ulcers. If we enquire into the circumstances which operate in the production of these *vegeto-animal* exhalations, we find the same diversity of opinion. Heat, moisture, and the accumulation of decaying vegetable and animal matters, are generally supposed to be essential elements in the production of this poison. In our own country, Intermittent fevers are most prevalent, and appear in a more severe form, in the autumn, after the heats of summer; the same has been observed in other countries.

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\* *Select Dissertations, &c., by Sir Gilbert Blane, Bart., p. 107.*

† *A Sketch of the History and Cure of Febrile Diseases, by Robert Jackson, M.D., vol. 1., p. 12.*

As these disorders have been found to prevail in warm climates, after the autumnal rains, on soils naturally dry, they have been attributed to the more abundant disengagement of Miasmata produced by the previous moisture. A certain quantity of rain has been considered necessary, and a superabundance of it supposed to check decomposition "by dividing and separating the matters to be decomposed, and obstructing the access of air to them ; and that it will be most abundant in that soil, which contains no more moisture than is really necessary for a complete decomposition of the animal and vegetable matters existing therein."\*

How, then, are we to reconcile this with what is reported to take place on the Coast of Africa ? There, according to Dr. Lind, they enjoy an almost total exemption from sickness during the dry season. He acknowledges that "there are many difficulties which occur in assigning a satisfactory reason why, in some countries, as in those between the Tropics, heavy and continued rains should produce sickness ; while in other places, especially in the southern part of Europe, a want of rain for two or three months in the summer, should have nearly the same effect, and bring on diseases almost similar."

This author attributes the sickness to vapours pent up under ground being set free by the rains. Thus, "the large rivers in the dry season being confined within narrow bounds, leave a great part of their channel uncovered, which having its moisture totally exhaled, becomes a solid hard crust ; but no sooner the rains fall, than this long parched up crust of earth and clay gra-

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\* An Essay on the disease called Yellow Fever, &c., by E. N. Bancroft, 1811, p. 199.

dually softens ; and the ground, which before had not the least smell, begins to emit a stench, which in four or five weeks becomes exceedingly noisome, at which time the sickness is generally most violent.”\* He states, that the rainy season continues about four months, so that before it is half over, when the country is deluged, and when, according to others, Marsh Miasmata are not extricated, sickness rages with the greatest severity.

In a paper published in the Quarterly Journal of Foreign Medicine and Surgery for 1821, we are informed, that fevers are most prevalent at the beginning and end of the rainy season ; and that prior to the rains, the country is healthy. During the rainy seasons in other tropical countries, Marsh Miasmata are not generated until some time after the rains have passed,—until the moisture has been partially evaporated,—when the stagnant pools have been to some extent dried up, leaving slimy margins,—where decaying animal and vegetable matters, acted upon by the heat of a vertical sun, and aided by a sufficient quantity of moisture, give rise to the formation of this *vegeto-animal* poison.

From the frequent occurrence of fever in situations where no swamps existed, it might have been presumed, that other causes would have been sought for ; but such appears to be the general conviction of the necessity of exhalations from the soil, that if they could not be found at the surface, they were sure of being discovered beneath it. In whatever part of the earth man has fixed his habitation, we shall find more or less vegetable and animal matter, and water, and consequently decom-

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\* An Essay on Diseases incidental to Europeans in Hot Climates, &c., by James Lind, p. 53.

position and reproduction; but it is in inter-tropical countries especially, where the earth is covered with a luxuriant vegetation, and swarms with myriads of animals of the reptile and insect tribes, that the process of putrefaction proceeds with the greatest rapidity. In situations where the earth is sheltered from the direct rays of the sun, by the dense foliage of the brushwood, the surface of the ground is covered with all the materials requisite for the production of this poison. If these Miasmata really owe their origin to this combination of circumstances, we should certainly find them in all places where wood and water exist, but this is far from being the case. It is said that air from marshy situations, when condensed, was found to contain a flocculent matter of an animal nature, resembling mucus, and which emitted a cadaverous odour. Others have found the air of unhealthy districts, purer than that from the summits of lofty mountains. In these marshy situations, fever is sometimes unknown, or only makes its appearance at long and irregular intervals of time.

The mountains of Jamaica afford an abundant supply of the sources of Miasmata,—they are covered to their summits with a rank vegetation, intersected by deep ravines, generally containing more or less water,—the heat is sufficiently great, and we ought to have remittents and intermittents in abundance. After many inquiries on the spot, I could never discover that these disorders were of more frequent occurrence than in other parts of the world; and, when they did occur, the disease was generally attributed to a sudden return to the colder and damper air of the mountains, after a temporary residence in the plains.

A convalescent Hospital was established on one of the lower mountain ranges, about 1,500 feet above the level of the sea, and in charge of an Assistant Surgeon attached to the Naval Hospital at Port Royal. To this more elevated station the convalescents from fever were sent, as soon as they were able to bear conveyance in a spring waggon, and to ride up the hill on mules. In many cases, the convalescence was rapid; but a few of those men who were still in a debilitated state, were attacked with Intermittent fevers, and Diarrhoea. Here the air was cool and pleasant, the thermometer being on an average upwards of 8° lower than at Port Royal. Heavy dews fall at all seasons of the year, during light winds or calms, and in sheltered places.

The houses of the Planters, in this part of the Island, are generally situated in the ravines, and near streams of water; and, although they are exposed to the cold and damp winds which come down from the mountains in strong gusts, they do not appear to suffer. Indeed, the air of the mountains is considered so pure and salubrious, that Invalids are often recommended to these elevated situations for a change of air. The propriety of this advice, however, in many cases is extremely questionable.

Another example may be adduced of an almost perfect exemption from sickness, in a situation where Marsh Miasma ought to exist. The town of Kingston, in the Island of St. Vincent, is situated at the bottom of a spacious semicircular bay, and at the foot of a mountain range, with high land on each side. These mountains rise abruptly,—are covered with wood to their summits, and watered by numerous springs and rivulets.

On the heights behind the Botanic Garden, about a mile from the town, the trees afford shelter from the direct rays of the sun, and in many places, there is a dense brushwood. The soil consists of a black alluvial mould, evidently arising from decaying vegetable matter. In one place which was evidently a water course in the rainy season, but then dry, the soil had been washed away to a perpendicular depth of about fifteen feet ; portions of decayed branches of trees were taken from the lowest part, and also some fragments of snail shells. On the surface, the ground was covered with leaves in different stages of decomposition, for upwards of eight inches in depth, into which the feet sank at every step.

The trade wind, which is not interrupted by land breezes, or at least in a trifling degree, blows over these mountains through the ravines, and falls upon the town in strong gusts during the evenings, charged with moisture, and such exhalations as may arise from the soil. There, then, we have all the elements necessary for the production of this *vegeto-animal* poison,—heat, moisture, decayed and decaying vegetable matter, with as large a proportion of reptiles, insects, and other animal matters, as is found in other tropical countries : yet, strange to say, the town of Kingston is one of the most healthy spots in the West Indies. Up to 1826, the last time I visited this Island, they had for many years enjoyed an exemption from those fatal fevers which prevailed in some of the other Islands ; and, I was informed by the Staff Surgeon to the Forces, who had long resided there, that it was as healthy as the most favoured spots in England.

It appears that certain doubts have been entertained by authors, respecting the effects of this noxious mate-

rial, as we find fevers attributed to various other causes. Dr. William Carrie maintains "that the unwholesomeness of low and moist situations in the summer and autumnal months, is not owing to any invisible Miasmata, or noxious effluvia which arise from the soil, and lurk in the air, but to a deficiency of the oxygenous portion of the atmosphere in such situations, in consequence of vegetable and animal putrefaction ; in conjunction with the exhausting and debilitating heat of the days, and the sedative power of the cold and damp air of the night."\*

Dr. Fergusson, who was employed in making a Medical Survey of the West Indian Islands, paid particular attention to the subject of Malaria ; and one of the conclusions which he draws, is "that Marsh Miasmata have no connexion with the putrefaction of vegetable substances."† Dr. Mc'Lean says, "it must be admitted too, that fatal Miasmata arise where there are no very certain appearances of a marshy soil. The Mole, and St. Marks, do not appear surrounded with marshes, and yet the fever rages at both those places with the greatest activity."‡

However authors' may differ respecting the production of this subtle agent,—the distance at which it operates, and other circumstances connected with its action on the human body ; they seem to agree generally on attributing to it certain properties. It is said to be of greater specific gravity than atmospheric air, in consequence of which, it forms a stratum over the earth's surface. These vapours which are exhaled during the

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\* American Philosophical Transactions, vol. 4., p. 128.

† Transactions of the Royal Society of Edinburgh.

‡ An enquiry into the nature and causes of the great mortality among the Troops at St. Domingo, &c., by Hector Mc'Lean, M.D., p. 25.

day, are said to be expanded—diffused through the air—and to be so much diluted as to be disarmed of their virulence. In the evening they are again condensed and return to the earth, there to combine with vapours arising from the ground, in consequence of the earth retaining its heat for some time after sunset, and diffuse pestilence around.

In support of this opinion it has been maintained, that the ground floors of buildings in warm climates are always the most unhealthy ; and that men stationed on elevated spots, even in the midst of marshes, are exempted from those fevers which prevail in the plains below. A height of a few hundred feet has been said to afford this protection, as is reported of Monk's Hill, at English Harbour in the Island of Antigua, and other places.

These, however, can only be regarded as isolated facts ; and it may be questioned, whether Marsh Miasmata acted as an element in the production of fever in some of these cases, as different results have been observed in other places. A regiment stationed at Up Park Camp, near Kingston, Jamaica, was marched to Stoney Hill Barracks as a precaution against sickness, from an idea, that a removal to the higher land would prevent disease. This station is upon the summit of a detached hill, about 1,360 feet above the level of the sea, and between the ends of two mountain ridges,—freely exposed to the sea breeze by day, and to the land breeze by night ; here, there is nothing like a swamp within several miles—yet even here without any obvious cause, fever made its appearance, and carried off one-fourth of the regiment.

It appears from official returns, that the presence or absence of swamps, have but little influence, either

in the production, or prevention of disease. "It is rather remarkable, that Epidemics generally break out here at a different period from that, at which they make their appearance in the low grounds. By contrasting the position, mortality, and fatal diseases of this station and Fort Augusta, we have a striking instance how imperfectly we can appreciate the cause of disease, or predicate with any degree of certainty, whether one locality is likely to prove more healthy than another. Fort Augusta is situated in the midst of marsh, or lagoons, abounding with that decayed vegetable matter, which is supposed to be a most fertile source of fever. While Stoney Hill is 1,360 feet above the level of the sea, and free from any such cause of disease; yet the deaths by fever have not only been higher than at Fort Augusta, in the proportion of 70 to 56; but this station has suffered from four severe epidemics, while Fort Augusta, though in the immediate vicinity of Port Royal, Kingston, and Up Park Camp, where that disease is so prevalent, and so productive of mortality, has been comparatively exempt from all but that of 1827." \*

With reference to the apartments on the ground floors being more unhealthy than those above, I can assert, from actual observation, that this is not always the case. During the prevalence of fever at Port Royal in 1828, seven patients, who were sent to the Hospital with surgical complaints, were attacked with fever, two of whom were in a ward on the ground floor, and five in the wards above. In 1829, six men, under similar circumstances, were attacked; two of whom were on the ground floor, and four on the floor above.

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\* Statistical Report on the Sickness, Mortality, and Invaliding among the Troops in the West Indies, 1838, p. 59.

If we trace the progress of epidemic diseases, we shall find that they traverse districts containing every variety of soil; and, in some instances, travel directly against prevailing winds. Air from situations where this invisible poison was supposed to abound, has been submitted to the most careful analysis, and found not to differ in its chemical composition from air obtained from places the most salubrious: while the most minute proportions of other gases, with which the atmosphere may be accidentally mixed, can be readily detected by their appropriate tests, and the relative quantities accurately ascertained. It is also an incontrovertible fact, that in all cases, in which noxious gases exist, they are equally injurious to plants as to animals. Wherever, then, we observe a luxuriant vegetation, we may feel assured that nothing exists in the air which is likely to prove injurious to man.

If these Miasmata be really capable of producing the effects attributed to them, they must be possessed of properties infinitely more active than the most noxious gases, or any known substance. If they produce such alarming effects upon the bodies of men, when diffused through, perhaps, a million times their volume of atmospheric air, we are irresistibly led to the inference that, at their source, and in an undiluted state, they must prove instantly destructive of animal life. Such, however, is not the case, as I have more than once had an opportunity of determining by actual experiment.

The swampy soil of Batavia is considered to be one of the most prolific spots on the earth's surface, in the production of these miasmal exhalations. Here I landed on the bank of the canal at midnight, about midway

between the town and the sea ; and being familiar with the foot-paths, walked upwards of a quarter of a mile, accompanied by the coxswain of the boat, a Malay. The ground was covered with brushwood ; in several places the larger trees and shrubs had been cut down for firewood, and the young shoots were growing up from the roots so close, that it was difficult to penetrate through them. In several places there were basin-like hollows, often containing a little stagnant water in the bottom, and the ground was covered with decaying leaves. We entered one of these basins adjoining the path, and separated from it by a narrow slip of brushwood. It appeared to be about twenty feet in diameter, being twenty paces in circumference, and from two to three feet in depth : it contained no water ; but on walking into it, I sunk over the shoes in soft mud, which was concealed by the leaves strewed over the surface. Being surrounded by pretty lofty brushwood, not a breath of wind was stirring ; the sky was unclouded, and the brilliancy of the full moon and stars almost rivalled the light of day. The ground was covered with a dense fog, forming a stratum of about a foot in thickness. Sitting down within the margin, I perceived a strong earthy odour ; and, after remaining at least ten minutes, knelt down with my face almost touching the ground, and made two deep inspirations.

After an interval of twenty-two months, I again visited Batavia, and tried the same experiment, in a similar basin, on the other side of the canal, and close to a pool of stagnant water, at one o'clock in the morning. On both occasions, the Batavian fever was prevailing on board of upwards of twenty sail of merchant vessels in the roads, taking in, or waiting for cargoes to Europe,

and at the distance of from three to six miles from the shore.\*

Similar attempts were made in Jamaica to ascertain the nature of these Miasmata, but with no better success. The mangrove swamps in the Pallisades, if they deserve that appellation, were repeatedly entered late at night, and before daylight in the morning. The air, the water, and the soil, were examined by the most delicate tests, in the hope of discovering some obvious cause of the ravages of yellow fever prevailing at the time: neither the air, the water, nor the soil, presented any sensible deviation from the usual healthy state.

Although the existence of Marsh Miasmata is maintained by most writers on the diseases of warm climates, the belief is by no means universal. Dr. Jackson, in his description of various localities in the West Indies, generally attributes disease to emanations from the soil; yet, it appears, that he is not quite satisfied with this cause on all occasions, as fever sometimes appeared where no swamps existed. Instead, therefore, of finding the cause in a few decayed leaves, he attributes all the mischief to living plants,—to a principle disengaged during an exuberance of vegetation. “It would appear that the materials of vegetation abounding in excess, acted upon by a powerful cause, give out a principle which not being expended on the growth and nourishment of plants, is diffused to a certain extent in the atmosphere, causing a derangement of such bodies as come within the sphere of its action.”†

Mr. Doughty, in different parts of his work, alludes to this principle; he says, “Marsh Miasmata which

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\* Vide Appendix.

† A sketch of Febrile Diseases, &c.

have been ascribed by so many as the cause of fever in all its varieties in the West Indies, does not appear to me by any means conclusive ; because the body's exposure to marshy exhalations at certain seasons of the year in Jamaica, does not produce any derangement of health." He continues "I am the more disposed to agree with an opinion which has been advanced, that, in the extrication of the principle of vegetation, there is imparted from the earth, in particular situations in the West Indies, and in climates of similar temperature, certain noxious exhalations, which produce effects on the constitution, in a ratio with the age and peculiar susceptibility to receive the morbid impression."\*

The existence of this "principle of vegetation," or that it operates in the production of fever, are mere assumptions without being supported by one single fact : in short, there is no such principle in nature. That the vegetation is rendered more luxuriant by rains, after a long continuation of dry weather, no doubt can be entertained; but this greater rapidity of growth, at certain seasons, is found to take place in all countries ; and if we examine the distribution of the vegetable kingdom in the West Indies, and every where else, we shall find, that plants are produced in greater luxuriance in some soils than in others. On removing them into a richer soil than that to which they have been accustomed, we find many examples of an exuberance of fertility. One of the most obvious and common, is the conversion of the stamens into petals, constituting double flowers. In our highly manured gardens, where these monstrous, or double flowers are cultivated, and with singular bad

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\* Observations and Enquiries into the Nature and Treatment of the Yellow, or Bulam Fever, by Edward Doughty. p. 3.

taste, so much admired, this noxious principle ought to be disengaged in abundance. In our own country, we never find double flowers in the wild state, neither are any to be found in the savannas of Jamaica, either before or after the rainy season. Each individual species is found on that soil which is most congenial to its habits; and, although its growth may be accelerated, or retarded, by an abundance, or deficiency of moisture, there is no reason to believe, that it ever proceeds to a greater extent than is sufficient to bring the seeds to perfection, and fulfil the great end of nature. Plants have the power of absorbing from the soil the materials necessary for their growth, but these materials are altered by the secreting and elaborating powers of the vessels, before they are appropriated to the nourishment or increase of the species. There is not the slightest proof, that they can effect any chemical change among the particles of matter, and give rise to the formation of a *tertium quid*, before the absorbed matters have entered their vessels; such a supposition is at variance with the laws which regulate the growth of organised beings. It must also be observed that, in tropical climates, that perpetual luxuriance of the vegetable kingdom, pictured by fire-side travellers, does not exist in reality. During part of the year, the vegetable kingdom has its interval of repose, and assumes the hue of autumn. In our own climate, about the end of April or beginning of May, if warm weather sets in, we find the vegetable kingdom, as it were bursting into life, and displaying as great a degree of vigour and luxuriancy in our fields and hedge-rows, as is ever observed in the West Indies. The belief in this principle of vegetation, therefore, is untenable: it is also much more limited in its application than

Marsh Miasmata, which, according to the believers in occult qualities, are alone sufficient to account for all the ills that afflict humanity.

According to another opinion, which appears to have excited some attention ; it was supposed that the decomposition of the timber of which the ship was constructed, might give rise to the formation of some gaseous material injurious to health. No actual proof, however, was ever brought forward in support of this opinion, and it is well known, that ships, both on the home and foreign service, have been affected with dry rot, without any sickness occurring.

The Serapis, the identical ship that engaged the celebrated Paul Jones, in 1779, had lain at Port Royal, as guardship, for many years, and was generally sickly. This vessel was at last sold out of the service and broken up. I examined her decks and holds, and had several portions cut out of her timbers, but no appearance of decay could be observed : the timber was hard, dark coloured, and well-seasoned oak.

On several occasions, fever has appeared amongst a ship's company, without any very obvious cause ; while vessels employed upon the same service, have continued healthy. As no general cause operating through the medium of the atmosphere, or the soil, would be thus limited in its operation, the disease has been attributed to Miasmata generated in the ship's hold. The supposition is a plausible one, and being in accordance with preconceived notions, the cause of the fever is at once explained. A survey is held,—a little bilge water, and slimy deposit, are found in the limbers and pump well: the hold is cleared and purified by fumigation, whitewashing, &c.

All this implies hard work for the ship's company, and unavoidable exposure to the sun, in landing the various stores. The fever continues to prevail, but when the purifying process is completed, it declines, and this is considered a proof of the efficacy of the means employed. This species of evidence, however, is far from conclusive. May we not with as much justice assert, that those whose constitutions were in that state to render them obnoxious to the disease, had been already affected by it; and on proceeding to sea, the change of circumstances altered that state of the system which constituted the disposition to an attack of fever?

The fever which appeared in the Pyramus frigate in the West Indies, about the end of 1821, and beginning of 1822; and in the Bann, on the Coast of Africa in 1823, afford curious examples of this description; and the former especially, of the caution with which conclusions should be drawn from official reports from ships. In the Pyramus, we are informed, on the authority of the Surgeon of the ship, that, "some time previous to the appearance of the fever, the foul state of the hold was sufficiently indicated by smells of a very disagreeable nature issuing therefrom, and diffusing themselves over the ship; and that a candle, when placed at "the mouth of the hold," was immediately extinguished."\*

In the official report, transmitted by a Staff Surgeon in the army, who was employed to investigate the cause of the fever on this occasion, we are thus informed of the effects produced by lifting the limber boards: "it is not in my power to describe the stench which issued forth on their being lifted. The boatswain, curious to

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\* Official Report of the Fever which appeared on board the Bann, &c. by Sir William Burnett, M.D., &c., &c.

see what we were doing, did not come down, but lay on the deck above to view us ; this confined gas rushed up the hatchway where his head was hanging over, so offensively oppressive that he fainted.” The parties who went down into the hold, did not suffer materially from the smell, which acted so powerfully on the more delicate nerves of the boatswain, although they felt its effects afterwards.

It appears from the same report, that the coal tar and bilge water, acting upon the chips and shavings, which had been left in the ship, by the carelessness of those who stowed the hold in the first instance, formed a kind of cement, which prevented the water from flowing into the pump-well ; “and when the pumps could no longer draw, the water and mud-like matter remained nine inches deep, just the depth of the timbers in the ship’s bottom.” From the limbers of the ship, and the spaces between the timbers, we are informed that “four large mudboats of filth” were taken away. There is something so extraordinary in these statements, as to lead to the belief that the reporter was misled by others ; as it is impossible he could have seen what he describes. When we consider the situation of the limbers, it is difficult to conceive how so great a quantity of filth could have accumulated there. These receptacles consist of a channel on each side of the kelson, running the whole length of the ship, and merely serve to convey the water to the pump-well. By actual measurement, the mean area of the limber of a 36 gun frigate, is one-third of a superficial foot ; then taking the extreme length for that area to be 100 feet, it will give 66 cubic feet for the contents of the limbers on both sides.

These channels are covered by pieces of two-inch plank, the inner sides of which rest against the kelson, and the outer, sloping downwards and outwards, are supported by a rabbet. No accumulation of gas can take place under these boards, as they are not tightly fitted, but merely laid on, to prevent any extraneous matters from falling into, and obstructing these channels. If the ship is not perfectly water tight, which very few are, they must be thoroughly washed out when the ship is at sea, and the deposit of any mud prevented every time the ship is pumped. With respect to the "four large mudboats of filth," from the spaces between the timbers in the bottom; no such spaces existed in the Pyramus. This ship, as can be proved by official documents, underwent a thorough repair at Devonport in 1818, and was filled in between the timbers; and the fillings caulked inside and outside, before the bottom planks were brought on. After the ship was planked, she was bored through the fillings from the inside, and injected with coal tar, to fill up any vacant spaces between the timbers and the bottom planks; and the aperture for the injecting pipe subsequently plugged up, to prevent the tar from escaping into the hold. This ship was strengthened by a diagonal truss frame from stem to stern post, and her bottom was one solid mass of timber.

The ships in ordinary, which are tight and thoroughly caulked before laid up, make but little water; and yet sulphuretted hydrogen is generated, and on pumping the ship, is immediately recognized by its odour. That it could not have existed in the Pyramus is evident, from the circumstance of a candle placed "at the mouth of the hold" being immediately extinguished. Had the

noxious quality of the air originated from this cause, or from the presence of carburetted hydrogen, a violent explosion would have taken place, as both gases are highly inflammable. Had carbonic acid gas existed in sufficient quantity to extinguish the flame of a candle placed within the hatchway, it would have speedily proved fatal to the first man who entered the hold. It is impossible to divine the nature of this light-extinguishing, and offensive smelling, gas, unless we attribute it to an after-thought; as the panic, which was general throughout the ship, seemed to destroy all power of observation.

The following year, when serving in the West Indies, I met with two officers who belonged to the *Pyramus* at the time the fever prevailed; and on making inquiries as to the truth of the various reports in circulation respecting her, was informed by one, and his statement was corroborated by the other, that a certain domestic kept an open grog-shop; and that drunkenness and irregularities, had more to do with the fever than a little bilge water, or a few dead rats in the hold. A staff Assistant Surgeon, whom I met at Barbadoes, informed me that he had visited the *Pyramus*, but added, with a certain sarcastic sneer, that his vision was then defective, and that he could not see so far as other people.

The fever which appeared in the *Bann* on the Coast of Africa, in 1823, was attributed by the Surgeon of the ship, and apparently with justice, to the climate of the Coast, in conjunction with intemperance on the part of the crew, and much exposure to the sun, while refitting the ship and her tender the *San Raphael*. As the fever in the *Pyramus* only the year before, had been attributed to a swamp in the hold, it seemed probable, that the

same cause might have operated in the production of fever in the *Bann*; yet when examined at Bahia, the hold was found perfectly clean. The limber boards, it appears, were not taken up; from which it may be fairly inferred, that no bad smells could have emanated from beneath them.

Admitting, however, that a quantity of slimy deposit, resembling a swamp, is allowed to accumulate in a ship's hold, from a want of common attention to cleanliness, it does not follow, that ships with clean holds, are exempted from fever. Examples may be mentioned of ships suffering severely from fever, where the most perfect cleanliness was preserved. The *Iphigenia* may be adduced as an example. Here, the highest state of discipline, and the most perfect cleanliness, were maintained, according to the reports of Drs. Bancroft, Adolphus, and Macnamara, which are preserved among the records at the Naval Hospital at Port Royal.

A similar fever appeared in the *Rattlesnake*, in 1824; and which, we have ample proofs, could not have originated from a foul hold. The *Rattlesnake* of 28 guns, was launched at Chatham in 1822. In the process of building the ship, the openings between the timbers below the lower deck, were filled in with wood, cement, and sand mixed with water. Within the bread room, holes were bored through the fillings, and a composition of linseed oil and air-slacked lime injected by a forcing pump; and all the length of the ship, before the bread room, was injected by the same means, with a composition of mineral tar and lime. The whole of the timber used in her construction consisted of English oak and plank, which had been immersed in salt water for three months.

As all the circumstances connected with the sickness, are most faithfully detailed by Dr. Wilson, then Surgeon of the ship, it may not be superfluous to take a general view of the causes, which appear to have operated in the production of disease. The Rattlesnake was a new ship, commissioned in December 1823, and arrived at Jamaica on the 29th June 1824. We are informed, "when this fever appeared in the ship, we had lain in Port Royal harbour, with the exception of five days, about six weeks; during which period the weather was perfectly dry, generally without a cloud, and the temperature high, Fahrenheit's thermometer varying from 82° to 90° in the shade. The sea breezes were generally strong; the land winds light, variable, and uncertain. In the night there was much lightning, with frequent meteors. The barometer, as usual in this country, stood with scarce any variation at 30."\*

"During the whole period, the ship's company was employed in clearing the hold, setting up the rigging, and dock-yard duty connected therewith. When the holds were cleared of their ordinary contents, there were found chips of wood, portions of mineral tar, and a small quantity of water under the limber boards." "A fortnight after these matters were removed, and when in our case they could not, therefore, have any effect." When the ship was as clean as it was possible to make her, the first case of fever made its appearance. Between the 8th July and 17th August, the process of cleaning and purifying the ship was going on. "The water tanks, provisions, &c., every thing, in fact, which the holds contained, were got on deck, and most of them

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\* Memoirs of West Indian Fever, by John Wilson, M.D., p. 148.

sent to the dock-yard, where they were cleaned, aired, and dried.”\*

Here we see an example of a ship’s company leaving England in the spring, with the winter constitution formed, and after a run of a month or five weeks, arriving at Jamaica during the hottest season of the year; while by night, the lightning and meteors indicated great changes in the electrical condition of the atmosphere. Instead of avoiding all unnecessary exposure, they were called upon to perform duties which required laborious exertion, and were exposed to a burning sun, and to the reflected heat and light from a white surface.

From the locality of the dock-yard, it is difficult to prevent the introduction of spirits among parties of men employed there: sleeping probably in the capstan house by night, the usual dormitory of a ship’s company, while these purifying processes are going on, they were exposed, when in a state of relaxation and fatigue, to the cold and damp air of the night. Dr. Wilson, with great truth observes, that “neither Marsh Miasmata, nor terrestrial exhalations of any kind, could have propagated the disease.” The nature of the duties on which they were employed, with the excitement by day, and the consequent exhaustion by night, were the exciting causes of disease; and, under similar circumstances, the same results may be expected to follow. On the 27th August, the ship sailed on a cruise to lee-ward. During a period of three weeks, the weather was squally, with heavy rains, accompanied by the most terrific lightning and thunder. She returned to Port Royal on the 27th September, with thirty-two persons

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\* *Ibidem*, page 147.

on the fever list. During this cruise the disease increased, and it is not unreasonable to conclude, that the change from harbour duty and fresh provisions, to night watching and salt diet, together with the unfavourable state of the weather, operated in the developement of fever in those, whose constitutions were more highly susceptible of impression from causes even of a trifling nature.

From the great mortality that has prevailed, at different times, among our seamen on the Coast of Africa, and the peculiar character of the disease, it has been supposed that some modification existed in the exciting causes ; and it was suggested that this might depend upon the presence of sulphuretted hydrogen, disengaged by the action of salt water upon the vegetable matter it contained. This opinion appeared to be strengthened, from the circumstance of water from different parts of the Coast, containing a considerable quantity of this gas in solution. There cannot be a doubt, however, that this gas was generated during the passage home, by the partial decomposition of the water itself, or of some vegetable or animal matter it contained. None of the officers who were employed on the late expedition to the Niger, were aware of the existence of any bad smells ; and many officers who have served on the Coast of Africa, have declared to me, that they never detected any particular smell, either in the air or water, in that part of the world.

In all warm climates, and even on our own coasts, especially during summer at ebb tide, a strong odour is exhaled from the sea weed, and from numerous crustaceous and molluscous marine animals. Admitting, however, that sulphuretted hydrogen is disengaged in

considerable quantity on the Coast of Africa, it may be fairly questioned, whether it be capable of producing the injurious effects attributed to it. It is disengaged from some mineral waters in considerable quantity ; from stagnant pools and ditches, and in the holds of ships. It is the cause of the offensive smell of bilge water,—has the property of tarnishing plate, and changes white lead paint to a brown or blackish colour ; but being diluted with many thousand volumes of atmospheric air, the unpleasant smell is the only inconvenience arising from its presence.

A peculiar earthy odour is perceived in a newly ploughed field, and after a shower of rain in the summer evenings. These odours, as also the perfumes from flowers, are much more powerful during a damp state of the atmosphere, which, when charged with moisture, appears to possess a greater conducting power than dry air. A similar smell is perceived by breathing upon portions of a numerous class of rocks, and which affords a character by which they may be distinguished in the dark. No person, however, for a moment imagines that there is any thing in these exhalations injurious to health.

It has been asserted, that the inhabitants of districts containing peat bogs, do not suffer from Intermittent fevers ; and it is not very obvious, why noxious exhalations should not arise from these accumulations of animal and vegetable matters, as well as in other cases. In these situations, too, we find dense fogs. The opinion that persons residing near peat bogs are exempted from Intermittent fevers, appears to have originated with Dr. Walker, formerly Professor of Natural History in the University of Edinburgh ; and has been repeated by

various authors, probably without taking the trouble to enquire. From my own observation, I am convinced that peat bogs in level countries, or of slight elevation, afford no such immunity. On the Dartmoor mountains, where peat is abundant, Agues are sometimes met with. If they are less frequent than in the lower lands, it is on account of these elevated districts being very thinly inhabited, and probably may be connected with the state of the air also. The preservative properties of Peat have been attributed to the quantity of astringent matter, and iron, it contains; and it has been said that animal bodies found in these depositions, had undergone the process of tanning. This argument, however, is untenable. The mangroves in the West Indies, which have been accused of giving rise to Malaria when in a state of decomposition, contain a large quantity of astringent matter, and have been used in tanning, as a substitute for oak bark. The wood also is very durable, and when of sufficient size, the stem is used as stakes for fences in damp situations.\*

With reference to Iron; every variety of rock, and every soil capable of supporting vegetation, contains this metal in various proportions. It is washed away by the rains, and deposited in hollow places and pools, where it forms deposits of bog iron ore, or is mixed with marl and clay. It has been found in the mud from the mouth of the Niger; it exists in the London clay, and

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\* There are three different plants denominated Mangrove, viz.—*RHISOPHORA* Mangle.—The red, or true Mangrove, grows in salt water, or within reach of the tide. The roots rise from the ground for several feet, to high water mark, when they unite and form the stem. The wood is hard, very durable, and is used for knees and ribs in boats, also for staves of casks, and shingles. It is superior to oak bark for tanning.

*CONOCARPUS* Erecta.—Button tree, is used as fire-wood, and is durable.

—Racemosa.—Foolish Mangle, or White Mangrove, both species are found in the sandy bays on the beach; are also astringent, and used in tanning.

at the mouths of the Thames and Medway, in the state of sulphuret, and earthy phosphate. On the beach, a short distance from Sheerness, and on the Isle of Dogs, the sulphuret may be obtained in considerable quantity, assuming the form of organic remains, and deposited on vegetable matters. This metal is found in all the supra-cretaceous rocks, as well as in those of the more ancient formation ; yet in the locality alluded to, argues are of common occurrence, notwithstanding the quantity of iron the soil contains.

That certain changes take place among the elements of organic bodies, when deprived of vitality, we have positive proofs every moment of our lives. During the putrefaction of animal matter, ammonia is formed by the direct union of its elements, and disengaged in considerable quantity, with various gazeous fluids. The elementary principles of vegetables are well known, as also the new combinations into which they enter, during the processes of fermentation and decomposition. The chemist can even anticipate the changes which will take place, under certain circumstances, and ascertain with the greatest accuracy, the relative proportions of the elements of these new products.

When we find a soil containing a sufficient quantity of moisture, abounding with vegetable and animal remains, and acted upon by heat, we have a combination of circumstances the most favourable for chemical action, and abundant proofs that it does take place. In the plains of Bengal, and other places, we find nitre produced, by the union of the alkali furnished by the soil, or the decomposition of vegetable matters, with the elements of nitric acid. Animal and vegetable matters when deprived of vitality, undergo changes in

obedience to established and immutable laws, varying, however, according to the circumstances under which they are placed; but resolved into similar products, when the causes which influence those new combinations are similar in kind.

During these natural operations, various gazeous fluids and volatile matters rise into the atmosphere, which no doubt, in time, would impair its purity; but while decay and dissolution are going on, the processes of regeneration and assimilation in the vegetable kingdom are in constant operation; and with chemical actions among the particles of inorganic matter, conspire to maintain it in a state fit for the support of animal life.

In all climates, in the evening, when the sky is clear, and when the air is not agitated by the wind, a fog is generally seen over pools of water, along the course of rivers, in sheltered places, and extending along the sides of hills. From this, the apparently obvious conclusion has been drawn, that the vapour was exhaled from the earth. If Miasmata, expanded by the heat of the sun, rise into the air during the day, they must be diffused through it by aereal currents, and cannot be again deposited in the spot from whence they originated.

With respect to the earth giving forth watery vapours, after the sun has withdrawn his beams, which meet and mix with the now condensed and descending effluvia, it is merely a gratuitous assumption; and not the shadow of a proof can be adduced to show that this ever takes place. It has been long known, that these fogs which are formed in the evenings, are not derived from the earth, but from the air surrounding the earth; and their formation is most satisfactorily accounted for, on the principle of the radiation of heat.

The earth, and every substance on its surface, has the property of receiving heat from the sun, and also of giving it off into free space. During the day, this is pretty uniform, but when the sun has sunk below the horizon, the earth continues to emit heat, and receives none in return. The consequence is, that its surface becomes colder than the air immediately in contact with it; and as the solvent power of the air is diminished by reducing its temperature, part of the water it held in solution is precipitated in the form of hollow vesicles, giving rise to the fogs, and to the heavy dew which collects on the leaves of plants. All places covered with vegetation possess a great radiating power, and this is easily proved by a very simple experiment. Any calm night when the sky is clear, if a thermometer, with the bulb covered with a little cotton or wool, be laid upon a grass plat, and another suspended in the air three or four feet above it, that on the surface of the grass will soon indicate a reduction of temperature, of several degrees lower than the one suspended.

When we bear in mind, then, that moist soils in all countries, are covered with a more luxuriant vegetation than dry ones, and consequently possessed of a greater radiating power, there is no difficulty in accounting for the origin of the fogs, with which such soils are covered.

If these vapours arose from the earth, in consequence of the heat it contained, they must occur under either a clear or cloudy sky, the air at the surface being possessed of a certain degree of dryness. It is found, however, that when the free aspect of the heavens is obscured by a curtain of cloud,—or even by a large sheet, or blanket, extended two or three feet above the surface, these vapours, or fogs, are not formed, and there is no dew

deposited ; and that the surface of the ground is covered with a fog only when the air is serene, and the sky unclouded,—circumstances the most favourable for the radiation of heat from the earth's surface.

These experiments were frequently repeated on the grass plat, in front of the Naval Hospital at Port Royal. The thermometers were generally placed soon after sunset, and observed at 8 and 10 P.M., and sometimes at midnight. A thermometer in the colonnade, and that suspended, would indicate the same temperature,  $74^{\circ}$   $76^{\circ}$   $78^{\circ}$  or  $80^{\circ}$  while the thermometer on the surface of the grass, would indicate a difference of from  $4^{\circ}$  to  $10^{\circ}$ . On lying down, and exposing my breast to the sky for the space of a few minutes, a most unpleasant sensation of cold was experienced, followed by a slight rigor.

In the preceding detail, it has been shewn, that we are utterly ignorant of the nature of this vegeto-animal poison ; that no two authors agree respecting its nature,—the circumstances under which it is generated,—or its effects upon the human body. How, then, are we to reconcile these discrepancies, with the existence of a material said to be possessed of such tremendous activity—a material, of whose existence we have no proof, and of whose physical qualities we have no knowledge ? What grounds have we for supposing, that the materials which are said to give rise to this mysterious and invisible something, should continue for indefinite periods of time in a state of inactivity, as far as regards its production, and yet be undergoing the changes inherent to organized matter all the while ? How can such materials let loose for a season, exhalations which kindle up the most untractable diseases, and again

become dormant? Such capricious movements among the particles of matter, are at variance with the established laws which regulate chemical action in all other cases.

All our reasonings, therefore, respecting the nature of these Miasmata, are founded on an assumption; and consequently want that certainty which constitutes the only sure ground of belief. The existence of this material can only be regarded as an assertion—a species of evidence which is not admissible in the inductive sciences; and until proofs be brought forwards of a very different kind from any hitherto adduced, we cannot acknowledge, without admitting contradictions and impossibilities, the existence of this *vegeto-animal poison*. The belief in such a material has an injurious effect, because it tends to suppress all observation and inquiry into the various causes of disease; whereas by close observation, and the correct application of well known principles, we shall soon find, that there are many powerful causes operating upon the bodies of men in warm climates; and which are fully sufficient to account for the ravages of disease, without the necessity of calling in the aid of aereal and unsubstantial phantoms.

## CHAPTER IV.

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ELECTRICAL STATE OF THE AIR.—MAGNETIC VARIATIONS—  
OSCILLATIONS OF THE BAROMETER.—ELECTRICITY DEVELOPED BY SECRETION.—INFLUENCE ON HEALTH.—SOL-LUNAR INFLUENCE.

INDEPENDENT of the causes already mentioned, there are other agencies in constant operation, which, if investigated with that attention the subject demands, will, in all probability, be found to exert a most important influence. I allude to meteorological changes in the state of the atmosphere, and the highly curious and interesting phenomena by which they are accompanied.

The electrical state of the air is liable to great and sudden changes, more especially during stormy weather ; and which appear to be connected with the state of the watery vapour in the atmosphere. Under ordinary circumstances, and during fine weather, the atmosphere is positively electrified ; and this state of electricity is stronger during the day than the night, but it varies in intensity during the 24 hours. About the time of sunrise it increases for two or three hours, and then declines, being generally weakest between noon and four o'clock. It attains its second maximum about sunset ; after which it diminishes, and continues feeble during the night. According to the observations of Saussure at

Geneva, electricity passes into the atmosphere during evaporation.

Some connexion appears to exist between the electrical state of the air, and those diurnal changes which have been observed in the magnetic variation ; and also, with the oscillatory movements of the mercurial column in the tube of the barometer. The variation of the magnetic needle from its mean position is easterly during the morning, and attains its maximum about eight o'clock. It then quickly returns to the mean position between nine and ten. It now changes to westerly, and arrives at its maximum about one o'clock ; afterwards slowly receding, until it again arrives at its mean position about ten o'clock at night. At Plymouth, according to the observations of Mr. W. Snow Harris, the barometrical oscillations are as follows : Maxima at 9h., 24m., A. M., and at 10 P. M. Here, it will be observed, that the oscillations in the barometer attain their maxima, at the same hours in the morning and evening, that the magnetic variations reach their mean positions.

These diurnal oscillations in the barometer are much more considerable and uniform between the tropics, than in the higher latitudes, and sometimes amount to one tenth of an inch. From a tabular view of the observations of Captain Sabine, it appears, that these oscillations decrease progressively as we recede from the Equator ; and are attributed to tides in the atmosphere, which extend as far as  $52^{\circ}$  of latitude.\* The changes in the pressure of the atmosphere, as indicated by the oscillations in the barometer ; the diurnal mag-

\* Meteorological Essays and Observations, by J. F. Daniell, F.R.S., page 254.

netic variations; and the fluctuations in the electrical state of the air, appear to have a connexion with each other; and probably depend upon some general law which requires careful investigation.

In the present state of our knowledge, it would be idle to indulge in theoretical speculations. It must be admitted, however, that Electricity is connected with some of the most important processes in the animal economy. In all cases of chemical action, or of the conversion of the elements of bodies into new products, it comes into operation, either as an agent in the production, or as the result, of these changes. During the passage of the arterial blood into venous, or venous into arterial; and in the processes of digestion and secretion, we have the strongest reasons for supposing that electricity is developed; and it has been proved, that the air in close rooms, vitiated by respiration, is negatively electrified. This state of the air in the crowded decks of a ship, when ventilation is neglected, may, possibly, operate as a powerful, but hitherto unsuspected source of disease. To ascertain the influence which these agencies, together with light and heat, exert over each other, and whether similar maxima and minima take place in the force of chemical affinity, under various circumstances, would require a series of the most minute and accurate observations which, perhaps, no single individual could accomplish.

It may be presumed that, as these oscillatory movements are extremely trifling in degree, they cannot exert any material influence on the laws of organic life, but this is an inference we are not warranted in drawing. If so small a fraction as nearly the eight millionth part of the force of gravitation, be sufficient to raise the tides of

the ocean, it is extremely probable, that the same power, in co-operation with other less obvious and hitherto concealed causes, may have some connexion with those periodical movements which take place in the system, as in the alternations of exercise and repose

*Sol-lunar influence*, has been supposed to operate as an exciting cause of disease; and although such opinions in the present day may be considered obsolete, it must be borne in mind, that the laws of nature are not liable to change. We see the power of sol-lunar influence over the tides of the ocean; and, as the gravity of all bodies on the surface of the earth is affected by it, it cannot be supposed that living beings are exempted from the same influence. On the contrary, the various and complicated actions constantly going on in the living machine, both during health and disease, would seem to render it peculiarly liable to the effects of these disturbing forces. Accordingly, it has been long observed, that the invasion, increase, and termination of many diseases, are connected with solar and lunar periods, thus “the periods of Quotidian fever are either catenated with solar time, and return at the intervals of 24 hours; or with lunar time, recurring at the intervals of about 25 hours.” “The periods of Tertian fevers, reckoned from the commencement of one cold fit, to the commencement of the next, recur with solar intervals of 48 hours; or with lunar ones of about 50 hours.” The periods of Quartan fevers return at solar intervals of 72 hours, or at lunar ones, of about  $74\frac{1}{2}$  hours. Many other examples of the influence of this power are given by Dr. Darwin, and although it may be difficult to explain the mode of operation, the fact appears to be fully established.\*

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\* *Zoonomia, or the Laws of Organic Life*, by Erasmus Darwin, M.D. F.R.S., section 36, vol. 2.

These investigations appear to have been entirely neglected or overlooked by medical officers in the public service, yet there is no class of men who have greater opportunities of contributing to scientific knowledge. The state of the atmosphere, and the intimate connexion which subsists between it, and the condition of the various functions of life, are of the utmost interest and importance, both in health and disease; and in this extensive, and yet untrodden field, a rich harvest may be reaped. An account of the temperature of the air night and morning, as inserted in the journal, without reference to other circumstances, is of comparatively little value, and cannot afford data for any practical results. The dryness and humidity, the sudden changes of temperature, and of the electrical condition, should be carefully observed. The radiation of heat in warm climates; the geological structure of the country; and the periods of the accession of diseases, are also objects of the greatest interest, and by common industry and observation, much valuable information might be obtained.

## CHAPTER V.

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CHANGE OF HABITS.—EXPOSURE TO THE SUN.—SUDDEN CHANGES OF TEMPERATURE.—EFFECTS OF COLD.—EFFECTS OF HEAT AND FATIGUE.—TALAVERA, AFGHANISTAN, CHINA, HEAT A CAUSE OF DISEASE.—COLLAPSE FROM COLD.—BOAT SERVICE BY NIGHT.—EXPOSURE TO FOGS.—MORAL CAUSES.—NEW ORLEANS, INDIA, CHINA, COAST OF AFRICA.

In the preceding pages, we have seen the physiological changes produced on the human constitution, by our migrations from the colder, to the warmer regions of the earth. It now remains for us to take a general view of the various circumstances, which may be considered likely to produce injurious impressions upon a ship's company; or to operate as the more immediate, or exciting, causes of disease.

On the arrival of a ship-of-war in the West Indies, after a run of a month or five weeks, and the winter constitution of the seamen formed, we shall find, that they carry the germs of disease within themselves, and which require only comparatively trifling causes to excite them into action. The buoyancy of spirits, the florid complexions, and the full and bounding pulse, produced by the change of climate alone, render them more susceptible of impressions from the ordinary exciting causes of disease. Independent of the change of climate, how-

ever, various other circumstances are to be taken into account. There is a sudden change in the habits of a ship's company. When in harbour, they are immediately placed upon fresh provisions, and have facilities of obtaining abundance of fruit from the bumboat people; and, indeed, it is sometimes served out in lieu of a portion of vegetables. Spruce beer, is also a favourite beverage, and sometimes two kinds are brought on board,—one for the officers, and another for the ship's company, containing a proportion of rum.

The first effect of this sudden change from salt, to fresh provisions, is very generally a relaxed state of the bowels for a few days. The seamen, entertaining a vague idea, that this is a salutary process, attribute it to the change of diet; and, as the health is not materially impaired, seldom complain, unless the diarrhoea becomes troublesome or protracted.

Exposure to the sun is one of the most powerful exciting causes of disease, both in its immediate, and more remote effects. The newly arrived European in a tropical climate, is unable to take active exercise under a vertical sun, without feeling its effects. A sensation of oppression on the chest is experienced, which an attempt is made to relieve, by making a deep inspiration, or sighing; there is a sense of fullness of the head, and, throbbing in the temples: the pulse is accelerated, and the heat of the body increased. In situations where the soil is rocky, or sandy, and destitute of vegetation, as about the streets, quays, or beach, the heat is more oppressive to the feelings, than would be expected from the temperature of the air in the shade. The earth glows under the feet: the reflected heat reverberates upon the face, and painfully affects the eyes. The inten-

sity of light also, appears to increase these unpleasant sensations. When the thermometer is at 86° in the shade, and a light breeze blowing, the heat is not oppressive ; and an hour's walk may be taken without fatigue, on the shady side of a range of buildings ; while walking exercise in the sun, for ten minutes or a quarter of an hour, will give rise to the symptoms above mentioned, in a greater or less degree.

On the arrival of a ship in port, after a run of five or six weeks from England, various duties are to be performed, which render exposure to the sun unavoidable. The ship looks a little weather beaten, and requires painting and repair ; the masts want scraping ; the rigging is to be overhauled, set up, and tarred. In these operations a number of men are necessarily employed, and exposed to a vertical sun for hours daily. The boats' crews, and working parties, are employed in various duties at the dock-yard,—sometimes sitting in their boats, or loitering about the wharves waiting for officers. On these occasions, opportunities occur of procuring intoxicating liquors, which further increase the excitement.

In some of the West Indian Islands, and other places within the tropics, parties of men are occasionally employed in cutting wood for fuel. On these occasions, they are not only exposed to the sun during the day, but the exertion they undergo is of a different kind, and greater than their ordinary duties require. Among a party of wood cutters, there is a certain degree of excitement kept up by the novelty of their employment, which is still further increased by the various frolics in which they indulge. On examining a party of this description, when they come on board in the evening,

the men appear fatigued, and there is a certain haggard and anxious expression of countenance.

If exposure to the sun produce these effects, it may appear paradoxical to assert, that cold, in a tropical climate, is equally powerful as an exciting cause of disease; yet this is sufficiently obvious, when the circumstances under which a ship's company is placed, are taken into consideration. In harbour, the night watches are discontinued; and on the lower deck of a line of battle ship, six or seven hundred men are suspended in their hammocks, while the ship is riding at anchor head to wind. The space allotted to each person seldom exceeds sixteen inches; and they are so arranged, that each man has scarcely his own length. Windsails are generally placed in the hatchways, and if properly trimmed, a considerable current of air is thrown down. The windsails in the fore and after hatchways are generally carried into the orlop deck; while those who sleep near the main hatchway, if a windsail happens to be there, are often incommoded by the cold air rushing down upon them, and take care to put it aside.

In situations of this kind, the temperature of the air in the lower deck, has frequently been observed at 90° Faht., and even higher, when the windsails had been neglected; while the air on deck did not exceed 70°, or 75°, and a strong breeze blowing charged with moisture. This moist atmosphere, having a greater power of abstracting heat from the body than dry air, produces a greater sensation of cold than the thermometer indicates; and on coming on deck, even from the ward room, a slight shiver, or chilly sensation, is experienced: yet, to this sudden change, numbers of

the ship's company are exposed, night after night, in going on deck to the head. Getting out of bed in a state of profuse perspiration, they will remain in this cold air for a time to cool themselves ; on returning to their hammocks, they feel chilled and restless, and some febrile attack succeeds. Many cases of fever, acute rheumatism, pneumonia, and dysentery, could be clearly traced to this cause.

The effects of exposure to heat and fatigue, in the production of disease among large bodies of men, were clearly shewn on various occasions during the late peninsular war ; and more especially when accompanied by great dryness of the air. Dr. Fergusson informs us that “the army advanced to Talavera, and in the hottest weather fought that celebrated battle, which was followed by a retreat into the plains of Estremadura, along the course of the Guadiana river, at a time when the country was so arid and dry for want of rain, that the Guadiana itself, and all the smaller streams, had in fact ceased to be streams, and were no more than detached pools in the courses that had formerly been rivers ; and there they suffered from remittent fevers of such destructive malignity, that the enemy, and all Europe believed that the British host was extirpated.”

The object of the author of this paragraph was to show, that deleterious exhalations may be disengaged from soils, where marshes, properly so called, do not exist. Leaving Miasmata, or exhalations from the soil, out of the question, it must be sufficiently obvious, that other powerful exciting causes were in active operation. The army was in the field, and kept in a state of exertion, and consequent fatigue, by those various movements which precede a battle. Destitute of those

comforts he finds in quarters, the soldier's sleep at night was disturbed,—his meals often scanty and irregular,—exposed to the heat of the sun by day, with his linen drenched with perspiration, and left to dry upon his back;—to the chilling dews by night, and to the cooling effects of radiation, and evaporation from the surface of the body, he was exposed to a combination of causes, sufficiently powerful, it might be presumed, to account for the origin of disease, without calling in the aid of any invisible agent. Yet these causes, so obvious and energetic, seem to have been almost entirely lost sight of, and the attention directed to the pursuit of a phantom. During the retreat of the army to Truxillo, in the hottest season of the year—the month of August—many cases of *coup de soleil* occurred, which were justly attributed to direct insolation: yet, to account for remittent fever, a little stagnant water is considered an essential element; or a dry and sandy country, which had been sprinkled by a few showers of rain, some weeks or months previously.

We have lately had similar examples in the expeditions to Affghanistan, and China. In the former case, the advancing army in passing through a mountainous country, suffered severely from the heat in the vallies; and subsequently, the cold by night was equally injurious to the native troops. In China, during the attack on Ningpo, the thermometer stood at 90°, many men fell down in the ranks, from the intensity of the heat alone, and which was rendered still more injurious by the absorbing qualities of the black caps, and red colour of the dress. It was remarked to me by an officer present, that the seamen suffered less from the heat than the soldiers; and the reason assigned was, that they did

not wear red coats and black caps, and that they had less weight to carry about with them.

The great increase of sickness during a long continuance of hot weather, has been often remarked, and has been lately confirmed by official returns. It is stated that "the unhealthy character of that period of the year in which the greatest degree of heat and moisture is combined, is not, however, confined to the West Indies, but extends also to the East, as well as over a large portion of the Northern Temperate Zone. In the Mediterranean stations particularly, the admissions into Hospital, and deaths among the troops, average nearly twice as high between July and October, as during any other months in the year.\*

Exposure to the sun by day, even when the heat is comparatively moderate, especially when conjoined with active exercise, produces a state of general excitement in the system, and occasions a great expenditure of nervous and muscular energy. The soldier, or seaman, when employed in active warfare, cannot change his dress, and rest himself for an hour or two on a sofa: he has no basin of water at hand to cool his throbbing temples; nor can he command a glass of wine and a biscuit to recruit his energies, and allow the excitement of a long march under a burning sun to subside gradually. The soldier, when in the field, and in front of an enemy, goes to sleep when and where he can. A stone wall, or a hedge, affords shelter to the regiment, and he sleeps

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\* Statistical Report on the Sickness, Mortality, and Invaliding among the Troops in the West Indies, p. 102.

It may be doubted whether moisture can be properly considered as an element in the production of disease. In the Mediterranean, the hottest season of the year is from July to October; during this period the air is dry and the ground parched; very little rain falls, and scarcely any dew is deposited, even on surfaces of the greatest radiating power.

with his goods and chattels on his back, and his musket in his hand.

The seaman, employed in boat service, is exposed to all weathers, and unprovided with either bed or blanket, his monkey jacket answers the purpose of both. Sent away, perhaps at midnight, on some hazardous service,—and the darker the night, and the heavier it rains, the more certain is he of success. When the work is done, he will help himself to spirits if within his reach ; but if not to be obtained, a piece of tobacco is a substitute, and he will go to sleep in his boat.

The effects of exposure to heat during active exertion, do not cease with the removal of the cause. The nervous system had been as much excited as the sanguiferous ; and as the actions of life cannot long continue in this unnatural state, a correspondent degree of exhaustion succeeds, which renders the body more susceptible of impression. In the evenings, there is generally a very considerable reduction in the temperature of the air. The effect of this is a sudden check to the previously excited, but now debilitated, capillaries of the skin. The secretory system is disordered ; the blood no longer combines with the necessary proportion of atmospherical oxygen, and an excess of carbon accumulates in the system. If the impression has been sufficiently powerful, rigors succeed, and actual disease makes its appearance, in the form of fever, dysentery, cholera, or some local inflammation.

In tropical countries, the changes in the temperature of the air have been described as exceedingly trifling in degree, and even by those whose long residence within the tropics afforded them ample opportunities of acquiring every information. Dr. Jackson says, “I do not

pretend to state the difference precisely, but I believe it will rarely be found to exceed six degrees within eighteen degrees of the line on either side. The degree of heat between the morning and evening of the same day varies also, but rarely, I believe, beyond the extent of six degrees on level plains near the sea coast.”\*

Other writers do not appear to have noticed the sudden and great changes, which frequently take place in the temperature of the air. These changes are greater, it is true, in some months than in others, but they occasionally occur at all seasons. At Port Royal, I have repeatedly observed a reduction of from  $15^{\circ}$  to  $20^{\circ}$ , in the space of half an hour. About sunset, when the sea breeze had died away, and the air was perfectly calm, a thermometer placed in an open balcony would indicate  $86^{\circ}$ ,  $88^{\circ}$ , or  $90^{\circ}$ . A strong land breeze charged with moisture, would now come down in strong gusts from the mountains, and reduce the thermometer to  $68^{\circ}$ , or  $70^{\circ}$ , and sometimes lower. At midnight, and at sunrise in the morning, the thermometer has been often observed at  $70^{\circ}$ , and  $72^{\circ}$ : the air was then cool and pleasant, and half an hour’s walk along the beach was most invigorating. Between nine and ten o’clock, when the land wind had subsided, and before the sea breeze had set in, the thermometer would be from  $84^{\circ}$  to  $90^{\circ}$ . From twelve to two o’clock, was generally the hottest period of the day; and the thermometer in the shade ranged from  $84^{\circ}$  to  $88^{\circ}$ . On one occasion, after a storm of hail at four o’clock in the afternoon, the mercury fell  $23^{\circ}$ , but again quickly rose.

These sudden changes in the temperature of the air, in co-operation with other causes, cannot fail to produce

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\* Sketch of Febrile Diseases, vol. 1, p. 2.

powerful impressions on the human body. When the ship is in harbour, a number of men generally congregate on the forecastle in the evening, to enjoy the cool breeze, and although grateful to the feelings, the practice is often productive of serious consequences. The duck frocks and trowsers afford a sufficient covering during the day, when the temperature in the shade is from 80° to 86°, and many degrees higher in the sun. In the evening, when the temperature is reduced by the cold land wind saturated with moisture, and consequently its conducting power greatly increased, warmer clothing is absolutely necessary. During calm clear nights, the radiation of heat, and evaporation from the surface of the body, farther co-operate as cooling processes.

Some striking examples of this kind occasionally occurred at Port Royal. Parties of men, who had been actively employed under exposure to the sun during the day, were sometimes allowed to go on shore at night, and frequently indulged in drinking and dissipation. Men in a state of intoxication were sometimes found in the street asleep, and brought to the Hospital in a state of collapse, with a feeble pulse, and a cold clammy skin. The nervous system had received a shock, and was so far enfeebled or exhausted, as to be unable to maintain the functions of life in that state of energy, necessary for the production of the requisite supply of animal heat. Taking into account also the loss of heat from radiation, and evaporation from the surface, it is probable that death, in a few hours, would have been the consequence.

Examples of this kind are not unfrequent in warm climates, and more especially among the seamen belonging to merchant vessels, where the men are not under the

same salutary discipline and restraint as in ships-of-war. A man goes ashore in the evening in perfect health, and is found dead in the morning, in some by-street or lane, without the slightest mark of external violence. In these cases, death is usually attributed to apoplexy, brought on by drinking, or some other excess.

Boat service by night is also a frequent cause of disease, and more especially on the Coast of Africa, where parties are sent up the rivers and creeks in quest of slave vessels. On the appearance of fever, Marsh Miasma is the cause assigned, and this is considered so obvious and satisfactory, that no other explanation is required. The real cause will be found to depend upon a derangement, or disturbance, of those complicated trains of actions in the animal economy, which in their harmonious co-operation constitute health: and to the production of this derangement, the various causes already mentioned have mainly contributed:—viz., exposure to the heat of the sun by day, with the concomitant excitement, and expenditure of nervous and muscular power;—and to the exposure to the cold and damp air of the night, when the body is in a state of exhaustion and debility, and without the means of maintaining an energetic action in the system.

Many examples might be adduced to show, that when the parties so exposed were supplied with spirits, or other stimulants, no injury was sustained from exposure to the night air; while in others, where the same provision had not been made, fever in the most malignant form ensued. A remarkable instance of this kind occurred on board the Tweed, in 1827. When on her way to the Cape of Good Hope, she touched at St. Jago. A Lieutenant, the Surgeon, and two or three Midship-

men, went on shore with the boat's crew, and remained there for the night ; and not being able to obtain shelter, slept in the open air ; the next day they returned on board, and the ship proceeded to sea. Within twenty-four hours, all who had slept on shore, with the exception of the Lieutenant, and two of the boat's crew, were attacked with the fever, and only one of them escaped, all the others died. The Lieutenant, and the two men who were not attacked, owed their safety as it appeared, to their having drunk a goodly portion of brandy, which kept up an action in the system, and enabled them to resist injurious impressions.\*

When seamen are employed on shore out of the ordinary course of their duties, they appear peculiarly susceptible of disease : and it is to the change of habits, in co-operation with other causes, that this greater susceptibility is to be attributed. The remittent fever, which attacked a part of the ship's company of H.M.S. Monarch last year, may be briefly alluded to as an illustration. In this case, Malaria, as is usual in similar instances, was the cause assigned.

This ship was dispatched to the Coast of Asia Minor, for the purpose of conveying from Xanthus, certain marbles and other specimens of ancient sculpture. She arrived on the 10th of May, and on the 12th, a party of men landed and commenced operations. The coast line consisted of sand hills, and the country within was alluvial swampy ground extending for many miles, with a large lagoon communicating with the sea on the one hand (the ancient harbour of Patera) and a river, with extensive swamps on the other. The country was

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\* Communicated by a most intelligent non-professional officer, who was on the station at the time, and who had no theory to support.

flooded for the purpose of irrigation, and the natives had retired to the higher lands. To facilitate the removal of the sculptures, a tent was pitched near the spot, about twelve miles from the sea, and another on the bank of the river, about four miles from the former. One party was employed in excavating and digging out these remains of ancient art, while another was clearing the ground, and making a road between the two encampments. The only means of conveyance was on gun carriages, which were drawn by the seamen and marines with great labour, and frequently required to be propelled by levers over the rough parts of the road. At the lower encampment, they were placed upon Pontoons, tracked to the sea, and embarked on board of a steamer.

During the day, the heat of the sun was very powerful, with heavy dews by night, and frequently cold piercing winds from the mountains. A trench was cut around the encampments to keep themselves dry, and during the last eleven nights they were on shore, it rained very hard. The water in the river was of a reddish colour, turbid, and of a disagreeable taste. The men brought their hammocks with them, but instead of being suspended, they were generally placed on the ground; and during sultry nights, many of them slept outside of the tents exposed to a heavy fog, which speedily wetted the clothing. The men employed at the upper encampment, and in the Pontoons, suffered most severely. Ninety-five were on the sick list at one time, of whom three officers, and fifteen men died, and about sixty were invalidated at Malta. The party from the Medea Steamer, also suffered severely, six died, and a number were invalidated. The fever appeared in the remittent

form; and every person who was employed on shore had an attack, and to them alone the disease was confined.\*

Here we have a striking example of the effects of exposure to the sun during the day, and to the dews by night, during a state of exhaustion; and by the repetition of these debilitating causes for a period of three weeks, the functions of life were thrown into a state of disorder, and fever induced.

Causes of a moral nature, also exert a powerful influence upon the health of large bodies of men engaged in active warfare. When the mental and corporeal energies are directed to any object, under the guidance of a leader in whom confidence is placed, the duties are performed with alacrity; the mind is buoyant and full of hope, and a confidence of success, even under the most unfavourable circumstances, will powerfully contribute to its attainment. During active operations in the naval service, when the mind is kept in a state of excitement, and the duties promptly and successfully executed, sickness rarely appears. In cases, however, where the issue has proved unfortunate in the first instance, or when circumstances have occurred to retard the accomplishment of the object, the men lose confidence in themselves, more especially if they observe any symptoms of indecision in their officers, and disease is excited by causes which, under other circumstances, would have been inoperative.

A few examples of this kind occurred during the late war, which clearly shewed the influence of the depressing passions; and the expedition to New Orleans, more

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\* The above statement was made to me by a most intelligent officer, who was present the whole time.

especially seems worthy of notice, because no injurious effects could arise from the heat of the climate. The force assembled at Jamaica about the middle of November, where the fleet remained until the end of the month, and arrived off the American coast about the middle of December. Part of the troops embarked in the West Indies, and must have been on board ship at least a month: but the greatest part of the force had come from the Mediterranean and England, and must have been ten or eleven weeks on board crowded transports.

The preliminary operations, previous to the disembarkation, were speedily executed, and towards the latter end of the month, the troops were on shore. All the difficulties, arising from the unfavourable nature of the country, were surmounted; the privations from want of shelter—exposure to a degree of cold often below the freezing point at night, and seldom above 50° during the day—the irregularity of their meals—and the galling fire of the enemy, alike passed unheeded. The ardour and energy of mind, by which all were animated, rendered them proof against the ordinary exciting causes of disease: they expected to make short work of it, and in that state of excitement, sickness was unknown. Foiled, however, in their efforts to obtain possession of the city after suffering severely, a retreat became unavoidable, during the most unfavourable state of the weather, and they embarked about the end of January.

The moment active operations had ceased, the chagrin of having been beaten by an enemy they had been taught to despise, and who would have fled before them in the open field,—combined with the fatigues they had undergone, began to operate, and sickness soon appeared in

the form of dysentery and fever. Although the country was swampy, disease could not with justice be attributed to Marsh Miasmata, as this agent is not generated at a temperature near the freezing point, or where the cold is so severe as to produce chilblains, from which many severely suffered.

During the expedition to Affghanistan, the advancing army suffered much from the heat of the sun, and also from fatigue in traversing the mountain region; the increasing coldness of the nights also produced powerful impressions upon the troops, both European and Native, especially the latter. On meeting with reverses, they appeared to lose confidence in themselves, and the anticipation of greater disasters produced a despondency of mind, which powerfully promoted the diffusion of disease.

In the expedition to China, a similar result followed, from a large body of men being placed in a state of inaction after continued successes. It appeared that the force was not sufficient in numerical strength to warrant farther operations; the army, therefore, remained inactive until reinforcements arrived. The Europeaus had facilities of obtaining intoxicating drinks, and in this state of inaction, disease made its appearance in the form of fever and dysentery. When the cold weather set in, it was found that a supply of warm clothing had been neglected, and the soldiers, especially the Native Indian troops, suffered most severely from this cause. The thermometer was often 15° below the freezing point, and many of the men were disabled by chilblains which terminated in gangrene.

It appears from accounts published, that during the summer months, the Capital of the Island of Chusan

was in an extremely filthy state, and surrounded by a flat and swampy country, with the thermometer varying from 84° to 94°, and the atmosphere contaminated with noxious exhalations. Yet, there are no proofs, that the air of the locality was the sole exciting cause of disease, as dysentery and fever were prevalent on board the ships, which were removed from the influence of these causes. The depressing passions, in this case, could not be supposed to operate; although something may be attributed to hope deferred. If, in the midst of success, men are suddenly thrown into a state of inaction, from a combination of unforeseen events, the worst consequences may be apprehended, and it is invariably found, that disease is more destructive than the sword.

The influence of the depressing passions is, perhaps, most strongly marked on the appearance of disease among a ship's company employed in a tropical climate, as on the Coast of Africa. From the great mortality among our seamen on that station, there is a certain dread of the climate, in which the officers to a certain extent participate. On the occurrence of disease, feelings of anxiety and alarm are excited: they become undecided, and have recourse to the expedients of fumigation, whitewashing, &c., while the disease gains ground. On these occasions, a young Surgeon is paralyzed; he bleeds, purges, and gives mercury, with other means so confidently recommended in books, but he finds them unavailing: the fever continues to spread, and carries off one-third, or one-fourth of the ship's company.

On the appearance of fever in a ship-of-war, employed on the Coast of Africa several years ago, she went to sea, and made the best of her way to the Island of

Ascension. The disease gained ground, the decks were crowded with sick, and a feeling of alarm, bordering upon despair, became general. The Captain, instead of visiting the seamen, adopting means to promote their comfort, and endeavouring to inspire them with confidence, shut himself up in his cabin with barricaded doors, and every crevice caulked, to cut off all communication with the ship's company. On his arrival in port, he immediately went on shore, placed himself in strict quarantine, and under the pretence of sickness, invalidated and returned to England. A similar example, perhaps, was never known to occur in the navy. Far different was the conduct of Lord John Churchill, when a similar fever broke out in the Tweed, in 1827. On proceeding to sea, he gave up his cabin for the better accommodation of the sick; visited them several times a day, and placed at the disposal of the Surgeon and his assistant, his stock of every description for the use of the sick. He himself took up his quarters with the officers of the gun room. Nor did his kindness end there, for he assisted the relatives of some of those that died; and to those who did not require pecuniary aid, he notified the death of their relatives and friends. In the one case, the men were in despair, and suffered severely, although they had the benefit of a most intelligent Surgeon, and the most appropriate treatment. In the other, the moral courage, and unremitting kindness of the Captain, inspired them with cheerfulness and confidence, and was productive of the most beneficial effects.

In the West Indies, it has been long observed, that new comers who entertain a dread of the climate, are generally the first to fall victims to fever, while those who are regardless of the climate, and adopt no farther

precautions than common prudence suggests, very generally escape. In cases where unusual precautions were adopted, the men became alarmed, and gave themselves up as lost. A remarkable example of this kind occurred on board the *Magnificent*. A party of marines, consisting of about twenty men, arrived from England to fill up vacancies. With the view of lowering the system, and rendering them proof against fever, they were marched into the sick bay, and bled freely when in perfect health. In the short space of three weeks, every man was attacked with fever in a severe form, and a large proportion died. This precautionary measure had the effect of creating a state of mental despondency and alarm, which powerfully acted as exciting causes of the disease. Indeed, this was so conspicuous, that the officers of the ship openly expressed their opinion, that the marines had been frightened into fever.

Another example of the effects of moral causes, combined with fatigue, and exposure to a certain extent, occurred in the late expedition sent to explore the Niger. In this ill-fated expedition, various circumstances conspired to excite gloomy anticipations. The professed object was the introduction of civilization into Africa, and which, no doubt, originated from the most philanthropic motives. Iron steamers were built for this special service, and the officers were appointed from their experience and local knowledge of the country, or interest in the cause. The seamen were volunteers, and received double pay. Stores of all descriptions were most liberally supplied; and, indeed, in this respect, there appeared to be no restriction. Wine and porter were put on board by hundreds of dozens, and large supplies of preserved meats and soups. A ventilating

apparatus was fitted to propel air into every part of the vessels ; and to purify that air, materials for the production of Chlorine were provided by hundred weights.

On minutely examining two of these vessels, when on the eve of departure from Plymouth, the accommodations of the officers and men appeared small, and were too much crowded. There was no berth for the sick, and they were completely filled with stores. The men appeared to be in good spirits, but it was evident, that they considered the enterprise hazardous ; and indeed, the whole tenor of the conversation of the officers shewed a perfect conviction in their minds, that sickness was expected as a matter of course. The unusual preparations that had been made constantly reminded the seaman, that he was entering upon a service different from all others ; and in a climate, he was led to believe, pregnant with pestilence and death. This gave rise to gloomy forebodings, and these feelings were still further heightened, by the frequency of religious exercises on board the ships, and exhortations to prepare for another world. This was unprecedented in the naval service. The seaman took no interest in the civilization of the Negro, and was out of his element. If placed alongside of an enemy, he would understand his position, and be able to clear his way ; but here he was subjected to a species of mental torture, but too well calculated to undermine both his moral and physical energies.

On tracing the progress of the vessels, however, we shall find that other causes came into operation, and which co-operated in producing a disposition to disease. The vessels sailed from Plymouth, on the 12th of May, 1841, and arrived at Maderia on the 21st, after a fine passage. They sailed on the 25th, called at Teneriffe,

and reached St. Vincent, one of the Cape de Verdes, on the 3rd of June. Here they remained clearing out and refitting, until the 16th. The weather was extremely hot ; the ships' companies had a great deal of hard work, and were necessarily much exposed to the heat of the sun. They reached Sierra Leone on the 26th, and sailed on the 2d of July for Cape Coast Castle,—called at Liberia, and afterwards at Grand Bassa, where they staid a week taking in coals, and then proceeded to Cape Palmas for a supply of wood.

On proceeding along the coast, they had almost constant rain for nearly a fortnight ; and both officers and men were much exposed to atmospherical vicissitudes and fatigue. Some slight cases of fever now occurred. They arrived at Cape Coast Castle on the 24th, and remained till the 31st ; then proceeded to Accra, and on the 9th of August, anchored outside the bar of the Niger, where they took in coals. On the 15th they crossed the bar, and another delay of five days occurred. On the 20th they commenced their course up the river with the most favourable weather,—the sky clear, with occasional refreshing showers, and the thermometer from 74° to 84°. During the passage up the river, both officers and men were much exposed in navigating the ships, surveying the river, and drawing up treaties with the native chiefs. Although awnings were spread, the heat is reported to have been oppressive by day, while by night, a heavy dew fell, and the air was cool. Some delays now arose in entering into treaties with the chiefs.

The causes which had been in operation for a period of three months, had now produced their effects, and rendered the system more susceptible of impression from any new cause, whether of a physical, or moral nature.

Their hopes, during the voyage, had been raised to the highest pitch, but they now saw but a faint prospect of their sanguine anticipations being realized. Fever appeared, and spread rapidly through the ships. The tolling of bells to prayers and funerals, amid the general gloom, was not calculated to inspire the mind with confidence and hope ; and according to the testimony of an officer present, a feeling of despondency and dismay prevailed throughout the ships. From the number of sick, the further prosecution of the enterprize was abandoned, after the loss of many valuable lives.

It is unnecessary to adduce farther examples : those already mentioned are sufficient to shew, that moral causes exert a powerful influence over the health of large bodies of men, as well as of individuals ; and that promptness and decision in the leader, the maintenance of cheerfulness of mind, and confidence in their own powers, are the most essential elements of success in naval and military operations.

## CHAPTER VI.

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SEASONING.—PHYSIOLOGICAL CONDITION.—INFLUENCE OF AGE AND MODE OF LIFE.—PREMATURE OLD AGE AMONG SEAMEN AND SOLDIERS.—PENSIONERS UNFIT FOR SERVICE.—SEASONING TROOPS FOR WARM CLIMATES.—NATIVE TROOPS.

WHEN the process of seasoning has been completed, or the just relation between the organs of supply and expenditure, arising from external circumstances, is fully established, the European may be considered as having become assimilated to the climate, and is likely to enjoy good health. In the West Indies, where extreme cold is unknown, the constitution is no longer summoned to make those efforts, that are necessary to maintain the relation of the functions of life with the varying conditions of surrounding media, which occur in the colder latitudes during the different seasons of the year; the mode of vitality is more uniform and less energetic: the nervous and vascular systems do not require the same degree of stimulation, and should be relieved, by the abstraction of stimuli, from those states of excitement which often lay the foundation of functional and organic derangements.

The period required for the completion of the process of seasoning, or assimilation to the climate, will depend

upon the age and habits of the individual. Young men of the sanguine temperament, and in the vigour of life, who indulge in the luxuries of the table, will be longer in acquiring this state of constitution, because the system is maintained in a state of plethora and excitement. Those, on the other hand, who are habitually temperate, less sanguine, and less prone to sudden impulses, bear the heat better; and when attacked with disease, it will appear in a milder form. Females, from their more temperate habits, and being exempted from active exertions, suffer less from heat of climate than men.

It has been observed, that men who have passed the meridian of life in England, suffer less from the heat than younger persons. This depends upon their physiological condition, and is only in conformity with a general law. About the age of eighteen or twenty, the body has attained its full height; that energy of vital action, which, for many years previously, was essential for the developement of the organic structure, continues unimpaired for twenty years longer, but gradually undergoes modifications. The size of the body is increased by the deposition of adipose matter, and by the greater expansion of the muscular masses. The fibrous and osseous structures become more consolidated, and acquire greater rigidity.

After the fortieth year, the vigour of manhood begins to decline; the fluids no longer predominate; secretion is more tardy; the skin is less vascular, and loses that softness of texture and warm glow of youth; the pulse becomes slower and weaker; nervous sensibility is diminished: in disease, inflammatory action is less acute, and the restorative power of the constitution is less energetic. This state of things is inseparably

connected with the state of the respiratory function, which exercises so important an influence over the body. It has been proved by actual experiment, that in men, the quantity of carbonic acid disengaged from the lungs is much greater than in women: this implies a greater consumption of oxygen, and a more vigorous action in the system. At the age of forty, when the individuals are in good health, the quantity given off is double that of the female. The proportion of carbonic acid now diminishes, and as old age steals on, it progressively decreases, until it is not greater than in childhood. We thus see, that the physiological condition of the body, at different periods of life, is inseparably connected with the respiratory, vascular, and nervous systems; and that these systems mutually act and re-act upon each other.

In cold climates, where the expenditure of animal heat is great, and the power of producing it feeble, the health is likely to be improved by a removal to a warm climate. Indeed, by adapting the ingesta to the power of assimilation in old persons, and removing them to a warm climate, there is no doubt that life might be prolonged. Even in our own country, in cases of debility, and in old persons, in whom the powers of life are feeble, external warmth is of the utmost importance.

The late Sir Joseph Banks, for years before his death, lived in a temperature of about  $80^{\circ}$  Faht. Being afflicted with paralysis of the lower extremities, he found external warmth necessary to compensate for the feeble power of producing internal heat. In young persons, from the fourth or fifth year, to the period of puberty, the growth of the body requires great energy in the power of assimilation; and in conformity with

this physical necessity, we find a corresponding vigour in the circulation, and an increased power of producing heat: the pulse is quicker, and the heat of the body is greater. The mean temperature of fifteen young persons, from four to fourteen years, was found to be 101° Faht., while the mean heat of twenty-one adults was 100° Faht.

This condition, however, is in relation with various external circumstances, as climate, mode of life, &c. : an illustration is afforded by children brought from a warm to a cold climate. If the power of producing heat is feeble, on arriving in England during the winter, they suffer much from the cold, or the sudden abstraction of heat ; and it is some time before the constitution accommodates itself to the change of circumstances. In many cases, the actions of life are not sufficiently energetic to maintain the relation with external agents, and they perish from disease of the glandular and respiratory systems. These effects of climate are not less strongly marked among the various species of apes, and other natives of warm climates, exhibited in collections of animals ; and if care is not taken to defend them from the cold and damp atmosphere, they die of tubercles in the lungs, or disease of the mysenteric glands.

Changes of climate, independent of their more immediate effects upon the human constitution, produce impressions of a more remote, and less obvious nature. Young men in the vigor of life, and of sound constitutions, shall resist for a series of years the influence of climate in every region, and escape actual disease. The actions of life, however, are maintained in a state of constant excitement, to resist the effects of heat in the warmer latitudes, and of cold, or the subtraction of heat,

in the colder regions of the earth. This wear and tear, if the phrase may be permitted, inseparably connected with their mode of life, is the cause of that premature old age which is so conspicuous among our seamen.

On examining a ship's company, men in their fortieth or forty-fifth year, appear ten or fifteen years older than they really are. The hair becomes grey, or falls off ; the pulse is slower and less expanded ; secretion is tardy ; the step is less firm and elastic ; there is a certain flaccidity of muscle, and they are subject to chronic rheumatism, and various other ailments. Few men, who have attained the age of forty-five, are fit for the active duties of seamen. A few years ago, when it became necessary to increase the naval force, there was some difficulty in obtaining a sufficient number of active young seamen. Men, who were in the receipt of pensions for former services, were allowed to re-enter ; and many were induced to take advantage of this regulation, with the view of completing a longer period of servitude, and obtaining an increase of pension. During the fitting out of the ship, they were generally incapable of much exertion ; many were sent to the Hospital, and others invalidated, and discharged as unfit for active service.

Various writers on the diseases incidental to Europeans in warm climates, have attached much importance to the process of seasoning, or preparing the body for the new climate. To effect this change in the constitution, it has been supposed, that previously to sending troops direct to the West Indies, it would be an advantage to place them for a time at Gibraltar, some station in the Mediterranean, or at Bermuda, where the heat was less intense, with the view of gradually preparing the constitution for a greater change. On several occasions, this

has been done, and apparently with advantage; while in other cases, it afforded no protection.

The nature of that physiological state of the system, which constitutes the power of resisting heat, has been already explained; and if all the circumstances, which tend to establish that condition, are attended to, it is probable, that sending troops to a more temperate climate for a year or two, might be advantageous; the exigencies of the public service, however, will not always admit of this being done, and in the case of seamen it would be impossible. In a regiment, the effective force gradually diminishes by deaths and discharges, and the vacancies must be filled up. If recruits, therefore, are to be sent to Bermuda, or some other intermediate station, to undergo the process of seasoning, such an arrangement would be impracticable. It has also been supposed, that men somewhat advanced in life, would be less likely to suffer from the heat of climate than young persons; but it has been proved by official returns, that age gives no protection against disease. "Instead of the mortality among our troops in the West Indies decreasing with the advance of age, as has been the general impression, it increases with infinitely greater rapidity than in this country: and the same has been found to take place at every station, whether temperate or tropical, to which similar investigations have extended."\*

The cause of this apparent anomaly is sufficiently obvious. The great majority of soldiers are young men; and if we except the non-commissioned officers, but few in the ranks will be found who have attained the age of

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\* Statistical Report on the Sickness, Mortality and Invaliding, among the Troops in the West Indies, p. 81.

forty. The constitution at that period of life has become, to a certain degree, impaired by frequent changes of climate and irregularities, and has less power of resisting injurious impressions. That rambling propensity, and aversion to labour, which in the first instance induced them to enter the service, is now satiated; they look forward to return to their homes, and having earned a pension for long services, and nothing more to gain, procure their discharge.

It appears, therefore, to be an erroneous opinion, that men who have served long in the army, and supposed to be seasoned to the climate, are best adapted for service between the tropics. They might be able to perform garrison duty; but for active service, where strength and energy are required, they would be totally unfit. It is at a later period of life, when men are incapable of active exertion, and whose impaired constitutions render them unfit for military duty, that the change from a cold to a warm climate is likely to prove beneficial.

There is another class of men in the service, among whom mode of life appears to have effected a considerable change of constitution, and rendered them more liable to disease; viz., the black troops in the West Indies. We are informed that "there is no country, either temperate or tropical, in which the mortality among the indigenous civil inhabitants between the ages of twenty, and forty, seems materially to exceed fifteen per thousand annually." Yet among the black troops and pioneers "forty have died out of every thousand annually; so that the rate of mortality is at least thrice as high among this description of troops, as in the native army of the East Indies."\* "Farther, the same liability

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\* Statistical Report on the Sickness, Mortality, and Invaliding, among the Troops in the West Indies, 1838, p. 11, ib. p. 12.

to a high rate of mortality, seems to affect negro troops in almost every quarter of the globe where they have been employed;”\* even at Sierra Leone, on the sea coast of their own continent, the mortality has averaged not less than twenty-eight per thousand annually; being about double the ordinary rates among other troops serving in their native country.

The black troops and pioneers, in the West Indies, consist of free blacks, generally more intelligent than the ordinary negroes. As they are natives of the country, and consequently assimilated, they cannot be supposed to possess any peculiarity of constitution, which renders them obnoxious to the climate; and more especially, as it is similar to that in which their parents or progenitors had their origin: as this greater mortality is also observed among the native troops on the Coast of Africa, some other cause must exist besides climate alone.

Let us observe the circumstances under which they are placed. Among the blacks in the West Indies, the quantity of animal food consumed is much less than the ration of a European soldier; yet, when these men enlist, they are at once placed upon a highly nutritious diet, to which they have never been accustomed, and which the wants of the system do not require: plethora is the consequence, and a greater liability to disease. With the native troops in India the case is different; here, religion interposes a barrier against an indulgence in animal food and strong drink. The rations of the native troops are different from those of the European soldier; yet it is more nutritious than that of the great majority of their countrymen in civil life; and by inducing

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\* Ibidem.

plethora, may operate as the cause of the increased rate of mortality amongst them.

On the Coast of Africa, the black troops consist chiefly of slaves captured on the coast, and liberated at Sierra Leone. These helpless beings are immediately put under the restraint of military discipline, and placed upon a full diet of animal food ; and that often salt provisions, to which they had never been accustomed. Diseases of the stomach and bowels, abscesses and ulcers, constitute about one-third of their complaints. This new mode of life, so contrary to all their former habits, is only calculated to excite surprise, that the ratio of mortality is not greater.

## CHAPTER VII.

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FOOD AND DRINK.—ESTABLISHED RATION.—REDUCTION OF ANIMAL FOOD IN WARM CLIMATES.—HABITS OF OFFICERS.—BOAT SERVICE BY NIGHT.

IN the preceding sections it has been shown, that health depends upon the reciprocal balance between the nervous and vascular systems; and consequently, upon the healthy state of the secretions. We have also seen, from a comparison of the physical characters of the different races of men, and by analogies from the animal kingdom, that the mode of vitality, or the energy with which the different functions is carried on, is modified by various external circumstances; and that under any given condition, where there is a considerable expenditure of nervous and muscular power, a corresponding supply of nutriment, a vigorous power of assimilation, and an abundant supply of atmospherical oxygen, are required to repair the waste.

The human constitution has the power of gradually accommodating itself to circumstances; or, in other words, certain trains of actions are established, which continue habitual under given circumstances, while the processes of assimilation and waste are in equipoise.

If the quantity of food be greater than the wants of the system require, a state of plethora will be the result, and become a predisposing cause of disease. If, on the other hand, the aliment be deficient in quantity or quality, the organic apparatus being deprived of their usual stimulus, will perform their functions with less energy,—the body will be reduced to a state of debility, and become more readily affected by injurious impressions. As modifications are impressed on the constitution by changes of seasons, which give rise to corresponding changes in the functions of digestion and secretion, it becomes an important object to proportion the aliment to the power of assimilation, and to the wants of the system.

Seamen, from the nature of their avocation, are subjected to great and sudden changes of climate, and experience corresponding physiological changes of constitution: yet, under these varying conditions, no provision is made to obviate the injurious effects connected with diet. The established ration of provisions is the same under an English winter, as in the hottest regions; although the calls upon the system are so very different, both in kind and degree. In the colder climates, the diet of seamen, both in quantity and quality, is found to be sufficient to maintain the energies of the system. If this be well founded, it necessarily follows, that between the tropics, where the abstraction of animal heat is less, and where the same energetic action in the system is not required, the stimulation must be in excess. That this is the case, is clearly proved by observation and analogy; and it becomes worthy of serious consideration, whether it would not be advantageous to reduce the ration of animal food, when serving

within the tropics; and also on those stations, as the Mediterranean, where during one-half of the year a high temperature prevails.

As the quality of the meat is now infinitely superior to that issued to the navy during the late war, two-thirds of the established ration will be found to contain quite as much nutriment: and that this proportion is sufficient is fully proved by the fact, that when soldiers are embarked on board of transports, or ships of war, for a passage, they are placed upon a reduced ration, viz., two-thirds of the allowance of the seamen. No complaint is ever made of an insufficiency of food, and their health and strength continue unimpaired. Formerly the quantity of spirits issued was half a pint of rum, or a pint of wine in lieu. This quantity of stimulating drink was too great, especially in warm climates, and intemperance was of more frequent occurrence than at present. The reduction of the proportion of spirits, and the substitution of tea in the afternoon, were important improvements in the scale of diet. When first introduced, indeed, it was regarded by some officers as a most disastrous innovation, and that it would lead to the deterioration of the seamen, and the ruin of the service; but experience has proved, that it has tended not only to elevate the moral character, but to improve the health of the ship's companies.

If thought expedient, a larger quantity of vegetable matter might be issued in lieu of the meat withheld; and to remove any idea from the minds of the seamen, that such a measure originated from any other motive than a desire to promote their welfare, an allowance in money might be made in compensation. It is only in warm climates, however, that it would be necessary to carry

this reduction into effect, and the experiment might be worthy of trial. In the West Indies, where ships are seldom long at sea, the ships' companies are supplied with fresh provisions and vegetables, and have facilities of obtaining fruit. Although this change of diet is salutary in its effects, in certain points of view, it tends to produce a state of plethora, which it is of the utmost importance to avoid.

With regard to officers, young men in high health, on their arrival in the West Indies, are but too apt to disregard all rules of prudence. The happy disposition of mind, resulting from that physiological condition induced by a change from the gloomy skies of an English winter, into a region where perpetual summer reigns, disposes them to enter into pleasures, without calculating on the probable consequences.

In the army, the drilling and various other duties are performed in the morning, while the temperature of the air is cool. They partake of a substantial lunch about one or two o'clock. In the afternoon, after the heat of the day has passed, the troops are on parade, and inspected by their respective officers. Five, or six o'clock, is the dinner hour, and after partaking of a good dinner, and a liberal allowance of wine, they retire about nine or ten o'clock, and on public days not until a later hour. At dinner, they appear in uniform, and sit with their tight cloth coats buttoned up to the chin. This is not a matter of choice, but of duty; and however necessary it may be to observe etiquette on the parade, it would be an advantage to dispense with it in the mess room. The comfort of the officers would be materially promoted by dining in their loose shell, or undress, jackets: and when the weather is very warm, the white cotton, or

linen jackets, which they generally wear in their quarters when not on duty. After retiring from the mess room, they disencumber themselves of their uniform coats, put on a jacket, and enjoy the cool air, with the windows of their rooms thrown open, smoke cigars, perambulate the streets, or play at billiards, until a late hour.

Under these circumstances, the system is kept in a state of excitement, and consequent collapse, which renders them more susceptible of the operation of the ordinary exciting causes of disease, and fever, hepatitis, or dysentery, follows as a matter of course. From the heat of the climate, in addition to stimulants, a feverish excitement is produced, and nature attempts to relieve herself through the skin. From the great increase of perspiration, thirst is excited, and as a free perspiration is considered salutary, copious draughts, in the form of weak brandy and water, wine and water, or sangaree, are taken to keep up the steam, as it is termed.

From the principles already explained, it is quite evident, that as there is an unnatural state of excitement in the body of the newly arrived European, these practices must necessarily prove highly injurious to health. The great object is to abstain from all stimulants, which are likely to increase the excitement of the nervous and vascular systems, already in excess, by proportioning the ingesta to the wants of the body in the circumstances under which it is placed. This is to be effected by carefully avoiding repletion, and at the same time, any great or sudden deviation from the ordinary habits of life.

During ordinary health, the bon vivant is not easily persuaded to relinquish his good fare, and his pint, or bottle of wine, after dinner; yet I have met with

examples of this kind in both services, and disease generally followed. Causes of a moral nature, however, were no doubt in operation. An officer, finding that his comrades are attacked with fever, begins to feel some little anxiety about his own fate, and makes a resolution to observe strict temperance. His duties are increased by the number already on the sick list; he becomes relaxed and languid from the want of his usual stimulus; the tongue is furred, and the hand tremulous; he considers his complaint bilious, for which he takes a calomel, or blue pill, and a seidlitz powder, and the following day is attacked with fever, or delirium tremens.

Although temperance is one of the most effectual means of preserving health in warm climates, under certain circumstances, a moderate allowance of spirits, is not only necessary, but salutary. In boat service by night, the great object is to prevent exhaustion: when the seamen, therefore, are fatigued by long pulling at the oar, a glass of spirits and water, and a biscuit, will recruit their energies. In cases where they are obliged to sleep in their boats, or on shore all night, a proportion of spirits will prove extremely useful in maintaining the powers of life, and preventing the effects of a cold and moist atmosphere.

With the same view, tobacco should be allowed; on those accustomed to its use, tobacco acts as a gentle stimulant; a general glow of warmth, and pleasurable sensations, are often produced by smoking a cigar, or by chewing the leaf. According to the old Instructions, when men were sent away by night, or early in the morning, it was recommended that a certain proportion of wine or spirits should be issued, with a dose of peruvian bark, as a preventive against the effects of

Miasmata. There cannot be a doubt of the propriety of the practice, but the dose would be infinitely more palatable and equally efficacious, if the bark was omitted, or given by itself. A basin of warm tea or coffee, with a biscuit, should always be provided before leaving the ship ; and during the night, or early in the morning, this refreshing beverage might be easily prepared by means of a small stove in the boat.

An apparatus of this kind, six inches in diameter by eight in height, might be provided at an expense of half a crown ; and by means of a pound of coal, and a few chips of wood, half a gallon of water might be boiled in twenty minutes. On the coast of Africa, and in other places, where the boats' crews are on shore all night, it is an object of the utmost importance to keep the men together, and prevent them from straggling into the native villages. Exhausted to a certain degree by the heat of the day, they require repose in the evening, but being excited by the novelty of the situation, if an opportunity offers, they will indulge in every species of extravagance and dissipation. Excesses of this description have a much more powerful influence on the body, than exhalations from the soil, and are generally the true exciting causes of disease.

## CHAPTER VIII.

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FOUL AIR IN THE HOLD.—SULPHURETTED HYDROGEN.—CARBONIC ACID.—ORIGIN OF CARBONIC ACID.—FUMIGATION.—NITRIC ACID GAS.—CHLORINE.—CHLORIDE OF LIME.—CHARCOAL FIRES.—CIRCULATION OF AIR.—DRY ROT; MODES OF PREVENTION.—COAL TAR.—CHEMICAL PREPARATIONS.—VENTILATING APPARATUS.

AN opinion has been long entertained that, in ships-of-war, accumulations of foul air take place, and produce deleterious effects upon the health of the ship's company. We have already seen the influence which has been attributed to gazeous products, said to arise from a foul state of the hold; and cases are not wanting of men having suffered from what is commonly termed, foul air, in the pump well. There is no doubt that carbonic acid, and sulphuretted hydrogen, are often generated in a ship's hold, and that they will produce injurious effects, unless largely diluted with atmospheric air. The existence of carbonic acid may be always ascertained, by lowering a lighted candle into the pump well: if it burns, we may be assured that there is no gas there that can prove injurious to health; if, on the contrary, the light is extinguished, or burns dimly, the cause is obvious. Sulphuretted hydrogen is immediately distin-

guished by its odour. It is not very obvious, in what manner these gases are generated, and it is a subject of interest in a chemical point of view. To afford a satisfactory explanation, however, it would be necessary to institute a series of experiments, of a very different description from any hitherto attempted.

It has been supposed, indeed, that when chips of wood, and other vegetable matters, are mixed with salt water, a decomposition of the sulphate of magnesia takes place: that, by virtue of the disposing affinity of the carbonaceous matter, a portion of oxygen is given off from the sulphate, and from the water, to combine with the carbon, and form carbonic acid, while the hydrogen set at liberty, takes up a portion of the sulphur from the sulphuret, to form sulphuretted hydrogen which is disengaged. It is not quite clear, however, that the sulphuretted hydrogen is produced in this manner, as the same gas is generated in equal abundance from fresh water, which contains neither sulphates nor vegetable matters.

With reference to carbonic acid gas, it is probable, that when found in the hold of a ship, it is chiefly the product of respiration. At night when the ports are closed, a very considerable accumulation must take place; and from its greater specific gravity, will descend through the hatchways to the lowest part of the ship, while the purer and lighter air flows in from above. Let us take, as an example, a frigate's complement of three hundred men sleeping on the orlop deck, and we shall find no difficulty in accounting for the origin of carbonic acid.

According to Lavoisier, and Sir Humphrey Davy, the quantity of oxygen consumed by an adult, in a minute,

by respiration, amounts to 32 cubic inches, which gives 46.080 cubic inches in the twenty-four hours. Dr. Thompson gives the consumption of oxygen at 40.009 cubic inches, or probably a little less. As the carbonic acid given off by the lungs, is about the same volume as the oxygen consumed, we have only to know the quantity of air respired in a given time, to ascertain the quantity of carbon it contains: and assuming the more moderate computation of Dr. Thompson to be correct, we shall find, that nearly twelve ounces of carbon are thrown off from the lungs of each person, during the twenty-four hours. The quantity of carbon generated by three hundred men in the same period of time, will amount to two hundred and twenty-five pounds,—a quantity sufficient, it is presumed, when in the state of carbonic acid, to fill the hold, and form an atmosphere, which would prove instantly destructive of animal life.

If the carbonic acid owed its origin, to the combination of the timber of the ship with the oxygen of the atmosphere, or with that arising from the decomposition of the water in the hold, we should observe evident marks of decay or waste; yet, on examining the timbers of a ship forty years old, the slight inequalities of surface produced by the adze, could be distinctly felt. The timber was hard and blackened, but no apparent decay had taken place in the ligneous fibres.

A belief in the existence of these noxious gases, together with infection, led to the adoption of various plans for their destruction, or removal. Upwards of half a century ago, when chemistry began to assume the form of an exact science, and the composition of atmospheric air had been accurately determined; it was supposed that, by her aid, we should be enabled to dis-

arm the atmosphere of noxious properties, and render it more congenial to animal life. The vapour of nitric acid was introduced with this intention, by Dr. Carmichael Smith, who received from Parliament a reward of five thousand pounds for his invention. The acid vapour is disengaged in the following manner. Two drachms of sulphuric acid are poured upon half an ounce of powdered nitre, placed in a gallipot, in a pipkin of warm sand. The acid unites with the alkaline base of the nitre, and the nitric acid is disengaged in the form of vapour, which is sufficient to fill a cube of ten feet. As this gas may be diffused among the sick without much inconvenience, it is perhaps superior to chlorine, when fumigation is considered necessary. It appears, however, that nitric acid vapour has now given way to chlorine, and the chloride of lime.

The disinfecting Phial of Morveau, was one of the most elegant contrivances of this kind. The chlorine was generated by pouring equal parts of nitric and muriatic acids, upon black oxide of manganese, and confining them in a strong phial, with a piece of ground glass applied over the mouth as a stopper. This apparatus was confined in a wooden box with a screw cap, and by unscrewing this cap half a turn, the chlorine escaped, and instantly destroyed infection in the air. This pretty plaything was at one time in great repute on the continent, and even in this country ; yet notwithstanding, people continued to contract fevers, and die as before. Chlorine is readily obtained, by the action of sulphuric acid upon a mixture of common salt, and per-oxide of manganese.

The chemical action which takes place is sufficiently obvious. The manganese employed is the tritoxide,

which easily parts with a portion of its oxygen. The sulphuric acid acts at the same time upon the muriate of soda, and manganese, forming sulphate of soda, and sulphate of the protoxide, and oxygen is disengaged; the muriatic acid and oxygen, thus presented to each other at the moment of their extrication, instantly combine;—the oxygen of the manganese with the hydrogen of the muriatic acid, to form water, and the chlorine is disengaged. Chlorine, however prepared, even when largely diluted with atmospheric air, has a strong and disagreeable odour, and produces a most distressing sense of suffocation. When in a more concentrated state, it is instantly destructive of animal and vegetable life. This gas immediately decomposes sulphuretted hydrogen, by combining with the hydrogen to form muriatic, or hydrochloric acid, and the sulphur is precipitated.

In cases where carbonic acid accumulates in a ship's hold, it may be very speedily removed, by adding a pound or two of quick lime to a bucket of fresh water, and sprinkling it by means of a broom into the hold. The lime rapidly combines with the carbonic acid gas, and is converted into chalk. The chloride of lime is now in common use as a fumigating material, and is superior to chlorine, as being more easily managed. In cases where the noxious gas consists of a mixture of sulphuretted hydrogen, and carbonic acid, the chloride of lime will destroy both. The affinity between lime and chlorine being extremely weak, the latter is disengaged by carbonic acid, and on being evolved acts upon the sulphuretted hydrogen as already mentioned.

When a ship is in commission, the propriety of using chlorine as a fumigating material may be questioned: it acts powerfully upon metals, and is injurious to rope and

canvass ; and as it is unrespirable, it must be got rid of by ventilation with atmospheric air, which, if employed in the first instance, would obviate the necessity of chlorine, or any other substance. Another mode of purifying the air in the hold, is by means of charcoal fires in swing stoves, which are carried to different parts of the ship. These fires may be useful in drying the ship, but so far from purifying the air, they only render it more impure than before. The result of the combustion of charcoal, or cinders, is the production of a large quantity of carbonic acid gas ; and we have many illustrations of its effects, in persons having been suffocated in apartments, in which a charcoal fire had been kept burning during the night.

Chlorine, however, has now become a fashionable remedy for correcting or destroying those various noxious gases, which are said to be so abundantly generated in a ship's hold. There are strong reasons for believing, however, that these vapours exist only in the imaginations of men, who are unacquainted with a ship. Bad smells can never arise, where ordinary attention is paid to cleanliness, and the officers are sufficiently aware of its importance. The greatest zeal is shewn in keeping clean the different parts of the ship, and the process of washing and scrubbing the decks, so far from being neglected, is often carried to the opposite extreme. In all cases, the accumulation of foul air is most effectually prevented by the use of very simple materials, of which a most abundant supply is always at hand, viz., the air without, and the water alongside.

When a ship arrives in port in a warm climate, it is an object of importance to secure her in that position, which shall admit of the decks being freely ventilated

by the prevailing winds. In most of the West Indian Islands, and indeed in all tropical countries, the sea breeze blows during the day, and the land breeze by night. The ship rides at anchor with her head to the wind, and if the ports are closed the temperature of the air in the lower deck becomes oppressive, and it is also vitiated by the respiration of so many persons. It has been already observed, that the ship's company often suffer severely from a sudden exposure to the cold air, by going on deck during the night. In these situations the ship should be secured with her broadside to the wind; and by sloping the lower deck ports, the air will be rendered pure and refreshing. In small vessels when in port, the ship's company, or a part of them, might be allowed to sleep on deck under an awning: this practice was adopted by Captain Sandom, when in command of the *Espiegle* at Port Royal, and the ship's company continued perfectly healthy.

Ventilation may be regarded in another point of view; viz., as the means of preventing the premature decay of timber, or, dry rot. It has been ascertained, that this process is most likely to commence where the air is not renewed; and that it does not take place when the air is perfectly excluded from every crevice, and the timber kept dry. The practice of filling in the spaces between the timbers, and injecting with a mixture of coal tar and lime, introduced by the late Sir Robert Seppings, completely answered this purpose, and rendered the bottom of the ship a solid mass. This composition acquires the consistence of bees' wax, and the lime destroys the inflammability of the tar. Soon after this practice was introduced, a great clamour was raised against it, and Parliament was called upon to interpose,

and prevent a practice which was described as ruinous in the extreme. This was to be proved by experiment, and a day was fixed. Being requested to attend, and report whether these experiments confirmed the assertions advanced, I proceeded to the yard of Messrs. Brown and Watson, at Limehouse, accompanied by the late Sir Joseph Yorke. The experiments were accordingly performed, and the conclusions drawn from them, displayed the ignorance of the parties of the mode of injecting ships, and their want of chemical knowledge. The Russell, 74, then on the stocks at Deptford, was visited ; she had been recently injected, and the composition having been forced through the crevices in several places, hung like icicles from the ship's side. Mr. Hume, who was present, was challenged to set fire to the ship, and applied a lighted torch to one of these depending masses of the compound, but it would not ignite ; and being perfectly satisfied, very candidly admitted, in his place in the House of Commons, that he had been imposed upon.

When the Russell visited this port a few years ago, she went into dock, and the timbers were found to be perfectly sound ; not an officer in the ship knew that she had ever been injected, although she contained 2,300 gallons in her bottom.

As it has been supposed that some noxious emanation may be disengaged from timber, when passing into decay ; it may not be superfluous to notice briefly the nature of dry rot, and the causes which appear to operate in its production. While the timber is in the growing state, and possessed of vitality, a complicated series of actions are in constant operation. There is a system of circulation of fluids, and a process analogous to respira-

tion and secretion in animals, by which the sap is changed by the absorption and evolution of oxygen and carbonic acid ; one part of which is appropriated to the growth and nourishment of the timber, while another is converted into the various vegetable products ; as gum, starch, resin, tan, &c.

When the timber is cut down, and the bark and leaves stripped off, the principle of vitality is destroyed : the watery parts of the sap are evaporated, and the less volatile ingredients deposited throughout the cellular structure. When timber is thoroughly dried, it is said to be seasoned ; and if applied to ship building, or any other purpose, it has but little tendency to decay, if kept in a dry state, or if excluded from the atmosphere by being kept under water. If exposed to a damp and confined atmosphere, moisture is absorbed ; a series of affinities between the constituents of the vegetable products are brought into action, somewhat analogous to fermentation, moisture is generated, a soft fungous substance appears on the surface of the timber, and the ligneous fibres are destroyed.

The late Sir Humphrey Davy, on directing his attention to the subject, suggested, that these changes might be prevented by saturating the timber with a solution of the bi-chloride of mercury ; and several years afterwards, a Patent was taken out for this process by another person, who had no claim to the invention. The bi-chloride is objectionable in several points of view, which it is here unnecessary to detail. Other modes of impregnating timber have been since adopted, and of all others, that introduced by Sir William Burnett, seems to be the most economical and efficacious. The chloride of zinc, not only prevents chemical actions from taking place in

the timber, but also destroys its inflammability ; and, according to numerous, and well authenticated reports, has proved a valuable discovery.

With the view, therefore, of preventing the accumulation of noxious gases, and keeping up a circulation of air through the lower parts of the ship, ventilation by means of windsails, is generally had recourse to ; and, if properly carried into effect, would supersede the necessity of any other mode. In warm climates, the windsails are generally used, and they convey to the lower part of the ship a large volume of pure air. In cold climates, however, or during cold weather, less attention is paid to ventilation ; and as the hatchways, and half ports on the main deck, are always open in large ships, no offensive smells are perceived, and the windsails are often neglected.

The mode of propelling fresh air into all parts of the ship, introduced by Dr. Reed, is perfectly efficacious, but it occupies much space, and is in the way ; and in large ships in commission, it can seldom be required, as no indications are ever observed of a noxious atmosphere, with the exception of carbonic acid occasionally in the pump well.

It occurred to me several years ago, that the fire in the ship's coppers might be rendered a most efficient agent, in maintaining a free circulation of air in the holds of ships. This object is to be attained, by supporting combustion in the fire place by air brought from the hold. According to the present construction of the coppers, the air is admitted through the space between them and the deck ; the combustion is imperfect, as may be seen from the volume of dense smoke issuing from the chimney, and there is consequently a great waste of

fuel. It is, therefore, proposed to carry a tube of sheet iron, or copper, to a few feet from the ash pit, and which terminates in a common deal trough, five or six inches square, carried along one of the beams, and down the ship's side into the lowest part of the hold: or, the metallic tube might be continued down the ship's side, or along the foremast. Smaller branches might be carried into the store rooms if required. The vacant spaces around the bottom of the coppers must be closed, to prevent the access of air from without. On lighting the fire, the air would rush through the tube from the lowest part of the ship, and be replaced by a current of air from above. By the adaptation of a damper to the orifice of the tube, or near its termination in the ash pit, the quantity of air admitted might be regulated with the greatest accuracy, and any unnecessary consumption of fuel effectually prevented. By this method of ventilation, every time the fire is lighted for the purpose of cooking the provisions, a rapid circulation of air through the hold would be kept up by means of this simple apparatus, which requires no attention, is perfectly safe against fire, and out of the way in carrying on the duties of the ship.

## CHAPTER IX.

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CHANGE OF CLOTHING.—CLOTHING BY NIGHT.—CLOTHING ON  
BOAT SERVICE.—CLOTHING IN A COLD CLIMATE.—DRYING  
WET CLOTHING.—BATHING.—CLEANING DECKS.

THIS is an object of much importance, both in cold and in warm climates, and inattention to this subject is often productive of great mischief. In private life, individuals are the slaves of fashion ; and if young and delicate females are permitted by their parents, to expose their bare necks to the weather, and their thinly covered feet to the cold ground, they must be prepared for the consequences of their own indiscretion ; viz., scrofula, pulmonary consumption, and various other ailments. These are matters not under the controul of My Lords Commissioners of the Admiralty, or the officers commanding Her Majesty's ships. In a ship-of-war, the case is very different ; the crew are supposed to be incapable of forming an opinion on these subjects, and that an essential part of their duty is a strict obedience to orders. On the home stations, at a certain season of the year, an order is given to wear white duck, and at another season, cloth trowsers. If the temperature of the air was always the same at these particular times, but little inconvenience could ensue ; but as this

is not the case in our changeable climate, the sudden change from the winter to the summer dress, and vice versa, frequently operates as an exciting cause of disease.

In our own country, however, any inconvenience may be obviated by wearing drawers, and flannel next the skin. In the West Indies, and other tropical countries, the white frocks and trowsers, and straw, or white hats, are worn ; and during the day are cool and comfortable, while the men are employed in the ordinary duties of the ship. It has been already observed, that a very considerable reduction takes place in the temperature of the air in the evening : that in harbour, the heat during the day is greater than at sea, and the coldness of the evening more sensibly felt, especially when land winds prevail. As the application of cold after the body has been heated, is one of the most powerful exciting causes of disease, it becomes an object of the utmost importance to adopt the necessary precautions to obviate its effects. With this view, it is desirable that a general order should be issued, that in all warm climates, whether at sea or in harbour, the ship's company should muster at quarters in the evening in cloth trowsers and jackets : or that, if they appear in white trowsers and frocks, they should have flannel drawers beneath, and a flannel waistcoat, or Guernsey frock. This plan was adopted in two ships on the Jamaica station ; the commanders highly approved of the measure, and I suggested to the Commander-in-Chief, the late Admiral Fleeming, the propriety of his giving an order, that the practice should be adopted throughout the Squadron. Whether such an order was ever given I am unable to say, but the practice did not become general.

On the Coast of Africa, where the ships' crews are often employed on boat service by night, blanket jackets, and trowsers, are frequently worn to protect them from the cold and heavy dews ; but it appears that this salutary practice is not always adopted. I have been informed by an intelligent officer, who had served for several years on the coast, that he was not aware of the existence of any standing order on the subject of changing the dress ; and that new comers pay very little attention to the dress of the seamen, as a means of preventing sickness. Those, however, who are acquainted with the climate, take the necessary precautions ; and the boats' crews who are furnished with flannel clothing, suffer less from exposure to the night air. During the night, the duck frocks and trowsers become damp from the perspiration and dew, and feel cold and uncomfortable. Flannel, on the other hand, maintains a gentle action on the surface, and being a bad conductor of both heat and cold, prevents the heat of the body from passing off, and also the sudden application of cold to the surface.

On the termination of the period of service between the tropics, the ship is replaced by another, and ordered home to be paid off. The change from a warm to a cold climate is now equally sudden, and the ship's company have to go through another process of seasoning as it were. Transported, in ten or fourteen days, from the Gulph of Mexico to the Banks of Newfoundland, they meet with a north west wind, and probably a few floating icebergs, and the temperature of the air is reduced to the freezing point, or within a few degrees of it. To guard against the effects of this sudden change, a liberal supply of warm clothing should be provided, and issued to the ship's company on reaching the latitude of 30° North.

A stimulating diet which, within the tropics, would have proved injurious, is now necessary to maintain the actions of life in full vigour, and enable the system to resist external impressions. From the variable state of the weather in the northern latitudes, the ship's company is called upon for greater exertions; and if the passage across the Atlantic prove tempestuous, affections of the chest, rheumatism, and diarrhoea, are of frequent occurrence. During wet weather, seamen often suffer from the wet or damp state of their clothing. On coming off watch, they have no means of drying it, and on going to sleep, it is stuffed into the clews of their hammocks to be again worn the next watch.

In ships-of-war, and more especially in a small ship, during wet weather, it is difficult to find the means of drying the clothing of the seamen; to hang wet jackets and trowsers between decks to dry, is displeasing to the eye of the first Lieutenant, who is always anxious to keep the decks clear. The clothing, therefore, is put into bags, and stowed away in the fore part of the deck, or in some other place where they are least exposed to view. This system of keeping the decks clear, is often carried too far; it is of infinitely less importance than a healthy ship's company, and to promote this, every other consideration should give way. Whenever the weather will permit, the bedding and clothing of the ship's company should be thoroughly dried and aired, and this can be easily effected by attention to existing orders. It is desirable that the officers of the different divisions, should be charged to pay particular attention to the clothing of the seamen, not only as a means of promoting health, by keeping the air on the lower deck in a state of purity, but with a view to the preservation of the

articles. If five or six hundred bags containing damp clothing, be thrown into a heap in the fore part of the lower deck, with the ports closed during wet weather, in a warm climate, oppressive and musty smells are soon generated : the atmosphere becomes charged with moisture, and in a very few days, mouldiness, or mildew of the clothing, will be found to have taken place.

Cleanliness in the persons of the ship's company is of essential importance, but it is frequently neglected ; and in cold and boisterous weather, the men are generally allowed to act according to their own feelings in these matters. If the face and neck are clean when they appear at divisions, more is seldom required. In warm climates, or in warm weather, facilities should be afforded for bathing, and this might be easily effected by having a few bathing tubs placed on the forecastle, or, in two or three-decked ships, on the fore part of the main deck. In warm weather, when the ship is becalmed, or if she is hove to in a light breeze, the whole of the ship's company might be able to indulge in the luxury of bathing without inconvenience. By suspending a sail by each corner from the lower, and maintopmast studding-sail booms, and keeping it sufficiently under water by a shot or two, fifty or sixty men might bathe at once, and without any risk to those who could not swim. In harbour, the practice of bathing ought to be more general, and the mornings and evenings should be preferred to the heat of the day ; it is highly salutary, and in general safe.

Dr. Moseley seems to entertain a great dread of bathing : he says "there is great danger in repelling the prickly heat ; therefore cold bathing, and washing the body with cold water, at the time it is out, is always

to be avoided : " also, " I dare not recommend cold bathing ; it is death with intemperance, and dangerous where there is any fault in the viscera."\* Bathing in cold fresh water, may probably prove injurious to dyspeptic patients who have resided long in a warm climate, but sailors are under very different circumstances. Bathing is salutary as a cooling process, and also by cleansing the skin. The only bath at their command, is the salt water alongside, and from the action produced on the skin by the stimulus of the salt, a chill is less likely to follow than if the water had been fresh.

I have seen men by scores plunge into the sea, at the time they were suffering from prickly heat, without any bad consequences following. The only danger to be apprehended from one or two persons bathing, arises from sharks ; but accidents from this cause are not of frequent occurrence. When a number of men are bathing together, even in the haunts of sharks, they never attack. In Carlisle Bay, in the Island of Barbadoes, I have repeatedly seen two or three hundred men swimming around the ship, without a shark appearing : the splashing and commotion of the water seemed to alarm them ; but the same evening, if the carcase of a dog or cat, procured for the purpose, was attached to a grating and allowed to go astern of the ship, several of a large size would make their appearance, and firing at them with ball was an occasional source of amusement to the officers. Cleaning decks, is another circumstance in the economy of a ship worthy of attention. This duty is generally left to the discretion of the first

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\* A Treatise on Tropical Diseases, &c., by Benjamin Mosely. p. 19.  
Ibidem, p. 73.

Lieutenant, who acts according to his own judgment. Some consider that the requisite degree of cleanliness can only be maintained by frequent washing, and scrubbing with cold water. Others wash the lower deck only once or twice a week, and generally prefer dry scraping and rubbing with stones and sand. The superiority of either mode of cleaning, will depend upon the state of the weather. In cold, wet, and stormy weather, the lower deck, if frequently washed, will continue in a damp state ; and as there is always more or less leakage from the lower deck ports, the air becomes saturated with moisture, and acts as an exciting cause of disease. It appears, therefore, that washing the lower deck once a week, is quite sufficient for the preservation of cleanliness ; and on these occasions, it should be dried as speedily as possible, by sprinkling it with warm sand, or by a fire of clear cinders in a swing stove. In warm climates, or during warm and dry weather, the same inconveniences are not likely to arise, and washing may be more frequently performed. The method of cleaning the decks with stones and sand, gives an appearance of extreme cleanliness, and also absorbs any moisture, or grease. The only inconvenience, is the quantity of dust generated, but this is unimportant, and not productive of any injurious effects upon the health of the ship's company.

## CHAPTER X.

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OBSERVATIONS ON FEVER IN GENERAL.—DIVERSITIES OF OPINION  
—THEORIES OF FEVER.—COMPARATIVE VIEW OF THESE  
OPINIONS.

THE term, Fever, is one of most extensive import, and the series of phenomena it embraces, whether regarded in a philosophical, or practical point of view, is calculated to excite the deepest interest. The attention that has been directed to this disease, or class of diseases, by physicians in all ages, and the ingenious theories that have been framed to account for the phenomena, afford an interesting subject of inquiry to the speculative philosopher. It also conveys to us a useful moral lesson, to trace the progress of the human mind through a succession of ages, and observe the slow developement of knowledge on a subject which so immediately concerns our welfare.

At different, and often distant, intervals of time, some enterprising genius has sprung up, who, dissatisfied with the existing order of things, and impelled by an enthusiasm perhaps inseparable from true genius, became the founder of a new system, which, for a time, reigned

paramount to the exclusion of all others. By some change in the mode of philosophising, or by the introduction of new terms, imperfections were discovered, which required additions or corrections, to render the union of its parts more harmonious ; until, from the vastness of the edifice alone, it crumbled into decay, and another, equally perishable, rose upon its ruins. During these successive changes of opinion, the discovery of the nature of fever has been the only object in view, and the explanation of its phenomena the ultimate end of all their theories.

Notwithstanding all that has been written on the subject of fever, opinions, the most opposite to each other, are still entertained respecting its essential causes, by men of equal eminence, and who may be considered to have been competent to weigh the evidence adduced in support of this, or that, hypothesis. Much of this diversity of opinion has, no doubt, arisen from our ignorance of the nature of vital action, and the modifications produced by the operation of external agents. On examining the subject more closely, we shall find that confusion has arisen from the use of indefinite terms, which convey no precise ideas ; and also from the difficulty of relinquishing preconceived notions adopted in the schools in early life. Almost every teacher has peculiar opinions on some points, and attaches to insulated facts a degree of importance, to which, in the opinion of others, they have no just claim.

In some of our latest and most approved systematic works, we meet with assertions respecting the operation of the remote and proximate causes of disease, advanced with a degree of confidence which our limited knowledge

by no means warrants ; and terms employed which, in many cases, seem only calculated to lead us deeper into error. In all our reasonings respecting operations involved in so much obscurity as the phenomena of disease, the most rigorous language should be employed ; the exact meaning of the terms we employ should be clearly defined, in order that the ideas they are intended to convey may be clear and precise. It is also of the utmost importance, that we clearly distinguish causes from effects ; such, indeed, is the importance of attention to these circumstances, that I am persuaded, a correct and fixed nomenclature will be a great step towards the improvement of the healing art.

As the class of readers for whom these observations are intended, are already acquainted with the theories of the schools, it would be superfluous to enter into details which cannot be productive of practical utility. It is my belief, that no theory of fever hitherto proposed is free from weak points, although all of them recognise, and are partly founded upon, important truths. It is to the question, is fever a primary and idiopathic disease, or is it merely symptomatic of some organic affection ? that I would more particularly direct attention. The consideration of this subject will necessarily lead to some detail, and require a brief survey of the opinions that have lately been, and are at the present time, entertained.

The opinion, that fever is a primary and idiopathic disease, seems to have given origin to those theories founded upon, what has been termed, the fibrous and nervous pathology. It would be foreign to the object of the present work, to enter into an exposition of the doctrines promulgated by Stahl, Hoffman, and

Boerhaave. It is sufficient to observe, that all that was valuable in their works, was moulded by Dr. Cullen into a beautiful and elaborate structure. The faithful descriptions of disease given in his works, and his reputation as a teacher in one of the most celebrated medical schools in Europe, conspired to extend his doctrines to the remotest bounds of the earth. Although blemishes were admitted to exist, even by his warmest admirers, his opinions had a great influence over the minds of medical men, and constitute an era in the history of medicine.

The remote causes of fever, according to Dr. Cullen, are confined to two sources ; viz., Human Effluvia, and Marsh Miasmata. The first giving rise to continued fevers, the latter to fevers of the remittent and intermittent type. These causes are supposed to be sedative in their effects, by which they diminish the energy of the brain,—produce a debility in the whole of the functions,—and particularly in the action of the extreme vessels. The proximate cause, therefore, constitutes the disease itself. This debility of the extreme vessels, produced by the application of sedative powers, gives rise to spasm, which he considers as a kind of re-action induced by the *vis medicatrix naturæ*, or salutary effort of nature, to throw off the morbid matter ; and which, in its turn, occasions an increased action of the heart and arteries, by which the lost energy of the brain is restored, and the spasm of the extreme vessels finally overcome. Thus, if we take a fit of ague as an example, we may apply this hypothesis to explain the phenomena of the different stages. After the sweating stage, the spasm is overcome, and health restored. This hypothesis, however, completely fails in two most essential

points: it furnishes no explanation of the return of the paroxysm; nor does it show how debility, in the first instance, produces spasm.

The system of Dr. Brown next appeared, which was new, in a great measure opposed to that of Dr. Cullen, and, in point of originality and ingenuity, had perhaps greater claims to attention than any that preceded it. There was an air of plausibility and boldness in his speculations, and from the simplicity of its principle, it gained many proselytes. In our own country, it does not appear to have been at any time generally adopted, although it produced a very considerable impression. In other countries, it met with a better reception, and obtained from foreigners a degree of celebrity for its author, which was denied him in his own country.

The excitability of Brown is similar to the nervous energy of Cullen, but excited, or exhausted, by the application, or abstraction of stimuli, and not under the control of the *vis medicatrix naturæ*. According to Dr. Brown, direct, and indirect debility, are the cause of all diseases. If the quantity of stimulus, or exciting power, is proportioned to the quantity of the excitability, health is the result. If a sufficient quantity of stimulus is not applied, the excitability accumulates, and produces direct debility. If, again, too much stimulus be applied, the excitability soon becomes exhausted, and produces indirect debility. If we come to apply this hypothesis to practical medicine, we find that the author classes diseases under two divisions; viz., sthenic and asthenic; and his mode of treatment is as simple as the arrangement. That regimen which we denominate antiphlogistic, cures the sthenic diseases, and stimulants the asthenic. In consequence of this

arrangement, the author associated together diseases the most opposite in their nature, and most contradictory in the plan of their treatment. Being but little acquainted with disease, from actual observation at the bed side of the patient, his descriptions are vague, and his system fails to explain the phenomena of fever, characterized by deficiency of action.

The sympathetic theory of fever of Dr. Darwin, was next introduced with pretensions superior to any other. *Zoonomia*, indeed, is distinguished by that boldness and originality of thought, which are so conspicuous in all the productions of this truly eminent man; and he enjoyed the opportunities which long and extensive practice affords, of becoming intimately acquainted with disease; but it is the lot of theorists to be satisfied with less evidence of the truth of their own opinions, than of those of others. *Zoonomia*, from the extensive field it embraces, and the metaphysical subtleties with which it is interwoven, requires attentive study to enable us to comprehend it in all its bearings; and this is probably one reason, why it is not more generally read. By those who are fond of the literature of the profession, and of following the discursive imagination of genius, the *Zoonomia* is well worthy of perusal, and will afford many ingenious explanations of curious and interesting phenomena. In the present day, it is spoken of as a thing gone by, and seems to have failed in realising for the author, that immortality which he fondly anticipated.

According to the systems alluded to, fever is a strictly idiopathic, or primary disease; in its own nature distinct from, and not necessarily connected with, any local affection; although it may be occasionally accompanied, in some part of its progress, with inflammation of par-

ticular organs. Such, as far as I have been able to discover, is the opinion of the generality of medical men of the present day, who are not converts to any particular theory ; and who, accustomed to reason on the nature of the phenomena presented at the bed side of the patient, can see no reason for depriving fever of its idiopathic title.

Amidst the doubt and uncertainty in which the subject was involved, an ample field was afforded for the exertion of genius. A new sect accordingly started into existence, who proceeded to demolish the already tottering neurological systems, and consign them to oblivion. According to these new, and more enlightened systems, fever is considered to be a non-entity, and expunged from Nosology. Fever, so far from being an idiopathic disease, and in the language of Dr. Cullen, “without any primary local affection” is declared to be merely symptomatic of some topical inflammation. The members of this sect, however, are by no means unanimous in their opinions. Several minor branches have arisen from the parent stem, each of which is supported by advocates more or less numerous, who loudly proclaim the infallibility of their own particular doctrines.

Dr. Clutterbuck, in this country, and Broussais in France, may be considered the great leaders in the dissemination of these new doctrines. Dr. Clutterbuck has fixed upon the brain as the seat of fever, and displays much ingenuity in support of this hypothesis. There appears to be some doubt, however, whether he is entitled to the claim of originality. Dr. Beddoes informs us, that Professor Ploucquet published two theses on the subject, in which he advanced a doctrine exactly similar

to that of Dr. Clutterbuck, four years prior to the appearance of his work.

Without disputing his claim to originality, let us take a view of his hypothesis. He commences with stating that “a disease may consist merely in disordered action, occasioning derangement of function, without any perceptible alteration of the structure, or organization of the part affected. In such cases, dissection after death can afford us no insight into the seat or nature of the disease.”\* This being the case, he proceeds to examine the essential symptoms of all fevers, and the state of the functions, and concludes with referring them all to the same cause. “What has been said above respecting the seat of fever being in the brain, applies not only to fevers strictly so called, but to the exanthemata or eruptive fevers, and to such as are attended with specific inflammation of certain parts, as *cynanche maligna*, *parotidea*, and perhaps others. In all these cases, there appears to be a double or compound affection; to wit, the external topical inflammation, and the fever that precedes or accompanies it.”† “Whatever, therefore, be the primary seat of common fever, it appears to be equally so of the various exanthematic fevers, and of those accompanied by specific inflammations.” Again, “it appears then that fever and phrenitis have their most essential symptoms in common, all of which are referrible to the brain and its functions; they are produced by similar causes; and the prognosis is the same in both. The feelings, referred by the patient to the head in fever, are just the same

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\* *An Inquiry into the Seat and Nature of Fever*, by Henry Clutterbuck, M.D., London, 1807, p. 13.

† *Ibidem*, p. 81.

with those of other inflamed parts ; viz., heat, pain, and throbbing ; whilst the functions of the brain are in every case more or less deranged : and, lastly, the general state of the system is the same as in other internal inflammations, due allowance being made for the influence which the brain exerts over various parts of the body, and which tends not a little to modify the general affection.”\*

In his recapitulation, he sums up his doctrine in these words : 1st.—“Fever is not originally a disease of the whole system, as is commonly thought, but a topical affection of the brain.” 2nd.—“That this affection consists in inflammation ; the general disorder observed in the system, or what is called the febrile state, being merely symptomatic of this, the same as in other inflammations.”†

Inflammation, according to Dr. Clutterbuck, is primarily and essentially a state of disordered action merely, though leading eventually to alteration of structure. From the latitude in which the term inflammation is employed, it is not very easy to attach any precise meaning to it ; and, as if aware of the difficulty of supporting his assertions by an appeal to facts, he attaches but little importance to post mortem examinations. According to this author, “the delicate structure of the brain renders it very unfavorable for accurate examination, it more quickly undergoes a change towards putrefaction than almost any other organ of the body, and previously to putrefaction, becomes soft and unresisting, rendering difficult or fruitless all attempts to observe it narrowly. This tendency to decomposition in the brain comes on in general so rapidly after death,

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\* Ibidem, p. 155. † Ibidem, p. 421.

that we are probably but little acquainted with its perfectly sound and natural appearance.”\* It is to be regretted, that this author has not furnished us with a description of those characteristic marks, by which a diseased may be distinguished from a healthy brain; and until this is done, it is scarcely to be expected, that his less enlightened professional brethren will subscribe to his assertions, in preference to the evidence of their own senses, without proofs of a different description from any hitherto brought forwards.

To the term inflammation, certain definite ideas are annexed: we understand it to imply the condition of a part characterized by certain visible signs, of which pain, heat, redness, and swelling, are the most conspicuous. Even in inflammations of the internal organs or their membranes, we find on dissection, preternatural vascularity, thickening, and opacity of membranes naturally transparent; adhesion of adjacent parts, effusions of lymph, serum, or purulent matter. Where these appearances do not exist in a greater or less degree, we have no reason to believe that inflammation existed. If the brain, or its membranes, were actually inflamed in fever, the disease would be much less tractable than it is found to be. Inflammation of this organ, either in an acute, or sub-acute form, is a very dangerous affection; while patients very often recover from fever accompanied with delirium, and other urgent symptoms, with little or no assistance from art.

In many cases, we find death occasioned by inflammation of the lungs, or other organs, without the brain presenting any deviation from what is considered to be its healthy state; and if we examine the symptoms

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\* *Ibidem*, p. 157.

at the commencement, and throughout the course of fever, we shall find that they indicate a state of things, in many cases diametrically opposite to inflammation. The hypothesis of Dr. Clutterbuck, then, is perfectly untenable, and is even subverted by some of his own arguments; yet the work contains many valuable facts, and appears to have had the effect of directing the attention of medical men to the relief of local affections.

The next hypothesis is that of Broussais, which has been proclaimed to the world, under the high sounding title of the Grand Physiological System. Finding the head already engaged, he made a selection of the stomach for the local habitation of fever. According to this view, fever is merely symptomatic of irritation, or inflammation, of the stomach and alimentary canal; the symptoms being modified by the extent and severity of the inflammation, the constitution and temperament of the patient, and other causes. The affection of the head which, according to Dr. Clutterbuck, is the cause of all the mischief, and the affection of the stomach merely symptomatic, is, according to Broussais, quite the reverse. The latter maintains that when the brain is primarily affected, that state is designated by the terms, phrenzy, arachnitis, or encephalitis; but he admits, that irritation of the brain, although secondary in fever, may rise to the degree of true inflammation. He maintains, that the essential fevers of authors, which through ignorance were considered independent of any organic affection, are merely symptomatic of gastro-interitis.

The bilious, or gastric fever, is only gastro-interitis in a person whose digestive canal much irritated, renders the locomotive muscles painful, and the bilious secretion

very abundant. Irritation, or inflammation of the stomach, causes the bile to flow there. If the inflammation occupies the lower intestines, the bile will flow in that direction, and produce diarrhœa. Should a certain variety of irritation retain it in the liver, it will be carried into the blood and produce jaundice. When the irritation changes into phlegmasia, or inflammation, it spreads over the whole of the intestinal canal, and produces the true gastro-interitis. This gastro-interitis is the cause of much mischief, and modified by the operation of adventitious causes, produces a variety of diseases, which have hitherto been considered as quite different from each other. Thus, yellow fever, plague, dysentery, and cholera, are attributed to this cause. Apoplexy, is said to arise from an irritation of the brain, produced by a disordered stomach. Gout and rheumatism, from irritation and inflammation of the brain, lungs, gastric channels, kidneys, bladder, &c. Rickets, scrofula, and a variety of eruptive diseases, are attributed to irritation of the viscera.

In some diseases, however, that recur in paroxysms, and leave the patient for a time apparently free from complaint, it was impossible to admit the existence of inflammation, or even a state of continued irritation; a class of intermitting irritations has, therefore, been introduced, which affords to the physiological physicians a satisfactory explanation of the phenomena of intermittent fevers. The shivering is regarded as an indication of the existence of irritation in the stomach, which augments the vital action of the organ; consequently, there is a rush of blood there from the external parts, which now become more sensible to the action of cold, or in other words, this visceral congestion by withdrawing

the blood from the skin, renders the patient chilly, and gives rise to the shivering. This irritation of the stomach, in a short time, excites the action of the heart, which propels the blood with greater force to the surface, and produces a sensation wholly different, viz., increased heat,—until the perspiration flows, which bears away all irritation, and terminates the paroxysm.

The mode of practice adopted in the treatment of intermittent fever, is quite in conformity with their views, and consists in the abstraction of blood from the epigastrium by leeches, or cupping, the warm bath, sugared water, or plain water. The exhibition of bark is considered by this sect as monstrous practice; although they are obliged to admit that it occasionally succeeds, by removing the irritation at an early period of the disease, before a high degree of engorgement has taken place; and that it will also sometimes succeed, when the gastro-enteritis has nearly subsided.\* It would appear, however, from recent reports, that the antiphlogistic plan is not always successful; some who have tried both methods, have asserted that the cure is much more speedily effected by Quinine.

In consequence of the facilities of intercourse between this country and the continent since the termination of the war, many of our countrymen have repaired to the French medical schools, and become initiated into the mysteries of the new system. I have met with medical officers in both services, who had become converts to this doctrine, and could descant most eloquently on the fœtidity of the breath, the fuliginosity of the tongue, and the mucosity of the digestive canal; and who, armed with leeches, or a box of cupping instru-

\* *Examen des Doctrines Médicales, &c., par F.S.V. Broussais, Paris, 1821.*

ments, with *eau de grosseille*, and mucilaginous ptisan, could beat even yellow fever quite out of the field. When disease appeared, however, and the new system was put in practice, the total inefficacy of the remedies was immediately apparent. The doctor, however, persevered, and the patients continued to die notwithstanding. Many men who were supposed to be ill, because the face was a little flushed, and the pulse quickened, after dinner, were entered in the sick list as cases of fever. An epidemic *Influenza*, which was prevalent at the time, also swelled the list of fever cases, and great credit was obtained for the successful result of the practice.

Another party may be mentioned, as occupying a middle station between Clutterbuck and Broussais, of which Professor Marcus, and Dr. Mills, may be considered the leaders. According to their views, Fever is not an idiopathic disease, but symptomatic of some local affection identical with inflammation, and varying in its type according to the nature of the organ affected. By thus extending the seat of fever to more than one organ, they have avoided many difficulties, into which a more confined view has led the disciples of Clutterbuck and Broussais; they can also account for a greater number of diseases, and apparently in a more satisfactory manner. Dr. Mills has certainly carried this doctrine to a ridiculous extreme; he draws comparisons between diseases essentially different in their nature, and brings forward the most fanciful analogies as proofs of their identity. Thus, *Pneumonia*, is typhus of the lungs; *Hepatitis*, typhus of the liver; *Ophthalmia*, typhus of the eye, &c.\*

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\* *A Comparative View of Fever and Inflammatory Complaints, &c.*, by Thomas Mills, M.D. 1824.

Such is a general outline of the various hypotheses that have been published to the world, under the specious appellation of theories of fever, and which have had a material influence in regulating the practical treatment of diseases. On comparing one theory with another, the views entertained by their respective authors with regard to the nature of fever, are the most opposite that can well be imagined. That all can be true is impossible; yet all are true to a certain extent, and the great error into which they have all fallen, appears to consist in their having taken too limited a view of the subject.

The progress of discovery in all sciences is slow, and from various causes, it has been more particularly the case in medicine. Hoffman was indebted to Stahl, Cullen to Hoffman, Brown to Cullen: and it was upon the excitability of Brown, that Darwin founded the sympathetic theory of fever. Notwithstanding the differences in their theoretical views, there is less difference in their method of treatment, than might at first view be imagined.

The indications of cure according to Dr. Cullen, are: 1st.—To moderate the violence of re-action. 2nd.—To remove the causes, or obviate the effects of debility. 3rd.—To obviate, or correct the tendency of the fluids to putrefaction. The first of these indications is fulfilled by the abstraction of stimuli, bloodletting, and the adoption of the antiphlogistic regimen. The second and third, by the exhibition of remedies calculated to support the strength. The sthenic diseases of Brown, are cured by bloodletting, purgatives, diaphoretics, &c. All diseases, however, as well as chronic

inflammations, are in their latter stages considered diseases of debility, and treated by stimulants.

The **IRRITATIVE FEVER**, with strong pulse, of Dr. Darwin, is the synocha of authors, and requires for its cure repeated venesection, emetics, cathartics, diluents, &c.

The **INIRRITATIVE FEVER**, with weak pulse, characterized by a deficiency of sensorial power, requires the exhibition of opium, and wine in small quantities: small blisters; warm and fresh air; sorbentia, and nutrientia.

The **SENSITIVE IRRITATED FEVER**, the phlegmasia of authors, is treated by venesection, cathartics, diluents, cool air, torpentina, &c.

The **SENSITIVE INIRRITATED FEVER**, is the typhus gravior, of authors, and is to be cured by an emetic, cathartics, venesection, if the symptoms require it; afterwards bark, wine, and opium.

From the view Dr. Clutterbuck has taken of fever, we might expect that bloodletting, and the strictest antiphlogistic plan, would be adopted. He accordingly places his chief dependence on these remedies, but by no means to the exclusion of others.

Emetics he admits, "when given at the commencement of the symptoms, and before the disease is so fully formed as to have acquired the force of habit, they often put a sudden and entire stop to its progress; and where they fail of producing this effect, they seem to check the violence of the disease, and mitigate its future symptoms."\*

The good effects of emetics he thinks is to be attri-

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\* An Inquiry into the Nature and Seat of Fever, p. 294.

buted to their "determining powerfully to the surface of the body, and relieving proportionally the internal organs from the force of the circulation." Sudorifics are also eligible remedies, if employed at the proper period.\*

Dr. Clutterbuck also admits, that fevers are sometimes cured by bark; but in these cases, he thinks, that the inflammation of the brain is of an erysipelatous nature, and when "the inflammation assumes an intermittent or remittent type, as is not uncommonly the case, it is found to be as much under the dominion of bark as fever itself in similar circumstances." After the first violence of action has subsided, and the disease has been protracted to a certain period (a period when it is necessary to fulfil the second and third indications of Cullen, and to combat the asthenia of Brown) experience proves, says Dr. Clutterbuck, that stimulating remedies may be employed with safety and advantage. He thinks it also probable, that in certain cases of fever, particularly in previously debilitated habits, the inflammation is of so inactive a kind as to admit the early use of stimulating remedies; and that when opium is so managed, as to obviate its disadvantageous effects, it becomes one of the most powerful means we possess of taking off fever, as well as other inflammations. Wine, and alkohol, are considered to be more powerful than opium, but in other respects analogous in their effects.

If we had the means of ascertaining the success attending the different modes of treatment, that have been adopted for the cure of fever, and comparing the ratio of mortality in a number of individuals, it would

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\* *Ibidem*, p. 346.

furnish us with the only certain method of determining the superiority of one practice over another. We have no data of this kind, however, that can enable us to draw correct conclusions. The advocates of each particular mode of treatment considers it the best, and asserts in the most unqualified terms, the great success attending it; while others, with the greatest care to fulfil every injunction, are not quite so fortunate, and consequently, are led to doubt its superiority.

As disease varies in different individuals, and is modified by a great variety of causes, we can scarcely hope to arrive at positive certainty on this subject. There can be no doubt, that diseases have been cured by the most opposite methods of treatment; or rather, that nature occasionally triumphs over every obstacle. Fever, when once established, whatever may be its nature, or wherever it may hold its habitation, seems disposed to run through a certain circle of actions, which our best laid plans are often inadequate to suspend or overcome.

## CHAPTER XI.

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PATHOLOGY OF FEVER.—PROXIMATE CAUSE.—IMPAIRED ENERGY OF THE HEART IN THE COLD STAGE.—RESPIRATORY FUNCTION.—CHANGES IN THE BLOOD.—INCREASE OF FIBRINE.—DERANGEMENT OF THE SECRETIONS.—ACCUMULATION OF CARBON.—STAGE OF EXCITEMENT.—STAGE OF EXHAUSTION—DIRECT, AND INDIRECT, DEBILITY.

As Fever, then, is considered to be an idiopathic disease, or to consist of a series of actions arising from derangement, or disorder, of the various functions of life, without being necessarily connected with disease of any particular organ; let us now endeavour to trace the nature of those actions in the organic apparatus, which terminate in actual disease. The term, proximate cause, is often employed in an indefinite sense. By some, it is used to imply those actions in the system which more immediately precede, and terminate in disease: according to others, the proximate cause constitutes the disease itself. If necessary to retain the term, it should be employed to designate, that deviation from the healthy state of the functions, in consequence of the nervous and vascular systems having acquired a new and unnatural mode of action, occurring as a sequence of the antecedent causes, and depending upon a certain undefined pathological condition.

Although it may be difficult to determine the exact point, where the effects resulting from the remote causes may be said to commence, they must nevertheless exist, though not evident to our senses, and form a link in the chain of causation, necessary to the developement of any particular fever. In illustration of this subject, arachnitis from insolation, may be adduced ; in which, in the space of half an hour from being in apparent health, the patient shall be labouring under delirium, although several hours may have elapsed from the application of the exciting cause. On the abstraction of blood, the buffy coat, or a firm coagulum, is almost invariably exhibited even at this early period. As this increased quantity of fibrine must be a product of secretion, or of some change it has undergone in its passage through the lungs, it is not easy to conceive how this change in the quality of the circulating fluid could have been effected in so short a period of time, unless we admit the existence of a series of actions in the living economy, and in which the nervous system performs a very important part, previous to the appearance of actual disease. When these latent movements in the system have proceeded so far, as to destroy or suspend the actions of health, actual disease may be said to have commenced, accompanied with its train of morbid associations.

In whatever way the exciting causes may operate, the nervous system appears to receive the first shock, as indicated by the diminution of vital action. In the incipient movements of fever, the heart participates in the general loss of energy, and propels the blood with less force to the extreme vessels : the consequent palleness of the skin, therefore, appears to be occasioned by

a diminution of propelling power, rather than by any spasm of the extreme vessels. Although the action of the heart may be more frequent in a given time, it is much less powerful than in health ; and, if we may judge from the apparent diminution of the calibre of the arteries, by the sense of touch, the quantity of blood circulating through them is diminished, and inadequate to maintain the equilibrium between the arterial and venous systems : hence, there is a preternatural distension or fullness of the venous trunks, especially of the portal vessels and vena cava.

This series of changes in the vital actions, seems to emanate from the state of the nervous system in the first instance ; but as this system is itself affected by the state of the circulatory system, new series of actions arise which modify all the subsequent phenomena. That fever, in the incipient stage, has its origin in the nervous system, and not in any particular organ, or system of organs, appears manifest from the well known fact that, local inflammations, and all diseases attended with excitement, are preceded by a stage of depression of longer or shorter duration, before any local affection manifests itself ; that, consequently, the affection of the nervous system precedes, and is a necessary link in the chain of causation leading to the developement of actual disease.

As the healthy state of the various organs destined to perform the office of secretion, depend upon the integrity of the nervous system ; so any deviation from the healthy state of that system, will be followed by a corresponding state of the other : that this is actually the case, is demonstrated by the paucity of the secretions in the first, or cold stage, of intermittent fever,

where the stage of depression is sufficiently protracted for observations on this subject. The mode on which these changes are effected, is, in the present imperfect state of our knowledge, enveloped in mystery. Yet even here, Chemistry lends her aid in throwing a ray of light on the subject, by enabling us to examine the relations of the respiratory function. During respiration in a state of health, according to the experiments of Mess<sup>rs</sup>. Allen and Pepys, the quantity of carbonic acid gas generated during respiration, is equal to the oxygen consumed; from which it was inferred, that no oxygen entered the system.

Different results, however, have been more lately obtained by Dr. Edwards of Paris. He informs us that, according to his experiments, a considerable difference was observable in the proportion of oxygen absorbed, to the carbonic acid produced, varying between rather less than one-half and one-sixth. The quantity of carbonic acid was very uniform when the circumstances were similar, but the general result is, that a smaller quantity of oxygen is absorbed during summer than winter. Independent, however, of the absorption of oxygen, it appears from his experiments, "that an animal breathing atmospheric air, also absorbs nitrogen, which is conveyed wholly, or in part, into the mass of the blood, and the absorbed azote, or nitrogen, is replaced by a quantity more or less equivalent to the azote exhaled, which proceeds wholly or in part from the blood."\* It is also an interesting fact that, from the beginning of May to the end of October, the quantity of nitrogen exhaled is greater than that absorbed; and that during the winter months the reverse takes place, the quantity

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\* *De l'influence des agents physiques sur la vie.* Ch. 16, p. 466 & 7.

absorbed into the blood being greater than that exhaled. "This view is not a preconceived notion ; but a result to which we have been successively led by a multitude of facts. It exhibits to us animal beings deriving from the composition of the atmosphere, two constituent principles of their economy."\*

I am not aware of any experiments having been made to ascertain, whether the absorption of nitrogen into the blood during the first stage of fever, is greater than the exhalation : if so, it might throw some light upon the rapid change which takes place in the blood. According to Gay Lussac and Thenard, the gelatine, albumen, and fibrine, differ but little in their chemical composition, but the latter contains the largest proportions of nitrogen and carbon. If differences are observed, during health, between the quantity absorbed and exhaled, under different circumstances, is it not extremely probable that similar variations may take place in disease ? and that the increased quantity of fibrine may be attributed to the conversion of a portion of the gelatine, or albumen, or both, into fibrine, by combining in the lungs with nitrogen which, in healthy respiration, is inhaled ; and that the carbonic acid disengaged from the blood when drawn from a vein, from its well known property of coagulating fibrine, materially contributes to produce the buffy coat, or a firm coagulum ? May we not also infer, that the blood having become more animalised by combining with nitrogen, or azote, acts as a stimulus to the heart and nervous system, and excites them into action ; or, in other words, is the cause of the stage of re-action, or the hot fit ? As the quantity of carbonic acid generated in the lungs, and also the quantity of azote absorbed into

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\* Ibidem, p. 423.

the blood, and exhaled from it, are found to vary under different circumstances, there appears to be nothing unreasonable in these views ; and more especially, when it is universally admitted, that important changes are produced in the circulating fluids by disturbance or disorder of the respiratory function.

During the collapse which takes place in cholera, and which may be regarded in the same light as the cold fit of intermittent fever in a more aggravated form, we are informed by Dr. Davy, that the respired air does not undergo the ordinary changes, and that the carbonic acid exhaled is diminished. Hence, we must infer that less oxygen is consumed, which enables us to account for the coldness of the skin, as the power of generating heat is less, and carbon accumulates in the system.

The changes in the quality of the circulating fluids, may be regarded in another point of view, and independent of the absorption of oxygen or azote in the lungs. The blood is the common fluid from which all the secretions are formed. It contains all the materials of nutrition, and after undergoing changes in its circulation through the lungs, which prepare it for the action of the glandular or secreting system, one portion is appropriated to the repair of the body, and the other expelled in the form of excretions. These excretions consist of highly animalised matter ; or, in other words, of materials which are not required in the process of reparation, or nutrition, and of which nitrogen is a principal ingredient. The urine, for example, consists of materials of which nitrogen is the principal constituent, and which are easily decomposed. If there is any arrest or disorder of the process of secretion, the elementary principles remain in the circulating mass ; and at the

temperature of the body, chemical affinities come into operation, which change the qualities of the blood. Upon this hypothesis we may, perhaps, account for the increased quantity of fibrine.

Independent of its chemical properties, it appears that the blood acts mechanically as a stimulus to the heart, and that this organ may be excited into increased activity by other fluids of a very different description. In some cases of cholera, during the prevalence of the disease in these towns, the saline injection was thrown into the basilic vein, and the effects produced were extremely interesting. The capillaries were injected; a flush appeared on the surface; the skin became soft and moist, and the pulse full. The injection was repeated in one person, when the effects of the first began to subside; and this increased action of the heart was maintained for hours, with comparative ease to the patient; no indications, however, were observed that secretion was performed, and the effects of the stimulus appeared to be confined to the heart and arterial system.

In the first commencement of the cold fit of ague, all the symptoms indicate a depression, or diminished energy, of the powers of life: there is a feeling of languor and weariness, occasional yawning and sighing, and a sensation of chilliness; the pulse is slower and weaker than natural; the skin becomes pale, with a certain roughness and harshness to the touch. During the rigors, the pulse becomes small, frequent, and sometimes irregular. The respiration is frequent and anxious, with frequent sighing, and there is a sensation of oppression at the præcordia. The dry and clammy state of the mouth, the desire for drink, and the palleness of the urine, indicate general disorder of the

secretory system. Here we find a series of symptoms connected with the state of the respiratory function, and showing that those actions, which separate the various principles from the blood, are impaired or altered. The heart, supplied by the coronary artery with imperfectly arterialized blood, is impaired in energy, and propels the blood with less force to the extreme vessels.

The effects, however, of this black blood are much more extensive; diffused through the whole of the arteries; it acts upon the nervous system through the capillaries, and impairs its energy. After this state has continued for a certain time, varying in different cases, a re-action takes place: flushes of heat are now felt, at first not generally diffused; if closely observed, some parts of the body will feel hotter than others, and especially about the chest. The pulse becomes regular, full, and strong; the breathing deeper, and more free; the oppression at the præcordia is relieved; the urine now becomes high coloured, but without depositing a sediment. During the sweating stage, the frequency of the pulse abates, the breathing becomes more free, the secretions are restored, and the general disturbance subsides. Here we see the same connexion with the state of the respiratory function. As the hot stage advances, the respiration becomes more free, or in other words, a larger quantity of air enters the lungs; the blood absorbs a greater quantity of oxygen, and there is an increased exhalation of carbonic acid. The heart now propels the circulating fluid with greater force to the surface, and the arteries feel as if distended by a column of blood, which was with difficulty transmitted through them. During this stage, we find all the organs and tissues in a

state of general excitement, or increased vitality, until after a time, the tumultuous actions subside, and a state of exhaustion equally general succeeds.

During this commotion of the general system, if any particular organ is slightly disordered, or disposed to take on inflammatory action, local determinations take place, and inflammation is likely to follow. This, however, can only be regarded as an accidental and secondary occurrence, and not as the cause of these actions which have preceded it. When local inflammation supervenes during the progress of the fever, the symptoms are modified by those characteristic of the local affection being superadded. In some cases of the more severe forms of fever in warm climates, the patient sinks into a comatose state during the period of re-action, and more especially where the stage of depression had been protracted. This was observed in some cases of the Endemic fever of Batavia, and also in the fevers of the West Indies. The nervous system was overpowered, as it were, by the deleterious influence of the black, or carbonised blood, and the patients died of a species of apoplexy. In these cases, dissection always showed great congestion of the venous system, and especially in the head.

It has been often, and very justly remarked, that excess of action is followed by fatigue or collapse. In the first stages of fever, it is equally true, that deficiency of action is followed by excess of excitement. After the stage of depression has continued for a time, varying in different individuals, according to the intensity of the impression made, and the constitutional peculiarities of the subject, the nervous system is at length roused into activity; a train of actions ensue, which at first

have a salutary tendency, and in the milder forms of disease, not unfrequently terminate in health.

During the prevalence of fever, we find great variations in the order and severity of the symptoms, in different individuals. In some, the different stages are not very distinctly marked, the powers of life are oppressed, and inadequate to maintain those actions necessary for the developement of the phenomena in their regular order. The pulse is small, and sometimes slower than natural; and the slight exacerbations may be regarded as ineffectual struggles to throw off the general disorder. This train of symptoms is often attributed to debility, a term which is sometimes used in the most indefinite sense. These actions are the result of a functional derangement of the organic apparatus, depending upon the state of the nervous and sanguiferous systems. On tracing the stages of fever in the relation of cause and effect, the stage of depression, or those first movements in the series of actions, may be regarded as the cause of what follows. During the stage of excitement, further changes are effected in the circulating fluids, which may in like manner be considered as the cause of collapse. As collapse, or debility, therefore, appears to be invariably a sequence of excitement, it must be regarded as the effect of the stage immediately preceding it; and that, as the powers of life are now exhausted, debility, properly so called, may be said to exist.

Although debility in the first stage, often supervenes to an alarming extent, and may even prove fatal without any re-action ever taking place, it is to be attributed to the sudden depression of the nervous system, and a more or less perfect suspension of the vital processes.

This may be termed direct debility: while the debility which succeeds excitement, arises from exhaustion of the nervous system, and may be termed indirect. Thus, we again arrive at the conclusion, that, notwithstanding the apparent diversity of opinion respecting the nature of fever, detailed in the preceding pages, the real difference is less than might be at first view supposed. All admit the existence of a stage of depression, excitement, and exhaustion, which appear to succeed each other in the relation of cause and effect, and which can only be regarded as indications of corresponding changes in the actions of life. To attain a knowledge of the causes of these states, or, in other words, to frame a true theory of fever, many most important phenomena must be carefully investigated; viz., the function of respiration, with reference to the changes in the inspired and expired air: the state of the nervous, sanguiferous, and secretory systems, under different conditions, and the connexions and dependencies that exist between them. In this investigation, chemistry will afford the most important assistance, but this aid must be applied by the hands of the Anatomist, Physiologist, and Physician.

## CHAPTER XII.

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### OBSERVATIONS ON THE EPIDEMIC FEVER OF JAMAICA, COMMONLY CALLED, YELLOW FEVER.

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#### SECTION I.—INVASION.—STAGE OF EXCITEMENT.—STAGE OF COLLAPSE.

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THIS Fever, as observed at Port Royal, made its appearance under circumstances unconnected with seasons, or any particular state of the weather. One ship would remain perfectly healthy, while fever was prevailing in another at the same anchorage, and a free communication kept up between them. In 1827, the 84th Regiment, lately arrived from England, and quartered at Fort Augusta, opposite to Port Royal, suffered severely from fever. After it ceased there, it broke out at Kingston and Stoney Hill. During this period, the ships-of-war at Port Royal continued healthy; or, if a case of fever occasionally occurred, it assumed the remittent form.

It would appear, therefore, that when fever occurs in an epidemic form, among a large body of men, it owes its origin to adventitious circumstances; or the peculiar susceptibility of the individuals attacked—however that susceptibility may have been acquired—rather

than to the operation of causes connected with the soil or locality. The histories of these visitations shew, that they have occurred in the West Indies at all seasons ; and during the three years I was in charge of the Naval Hospital at Jamaica, fever prevailed during that season of the year which is usually considered the most healthy ; viz., from November till May. This fever is characterized by a certain series of symptoms common to all, but differing in intensity in different cases. These diversities appear to depend upon the age, previous habits, and temperament, of the individuals, and upon the system of organs more particularly implicated. In the great majority of young men, the nervous and vascular systems were in a state of high excitement ; while in others, more advanced in life, or possessed of certain constitutional peculiarities, the symptoms denoted a less perfect developement of febrile action. As a ship's company consists chiefly of young men in the vigour of life, I shall attempt to describe the disease as it actually appeared, noticing those variations that were observed in the nature, or intensity of the symptoms, in particular cases.

In many instances, the disease was evidently excited by active exercise, and exposure during the heat of the day, or to the cold and damp air by night. In some, the invasion was sudden, the patient falling down in a state of prostration, or he had been slightly indisposed for a day or two previously. In other cases, the disease was ushered in by rigors, succeeded by vomiting, giddiness, and some confusion of ideas ; if asked a question, he seemed incapable of describing his feelings. The general system appeared to have received a shock, which it is difficult to describe in words : the skin was cool,

the pulse weak and oppressed. Flushes of heat now succeeded, general soreness over the body, headach, and pains in the back and limbs. As the febrile action proceeds, the most prominent symptoms are frontal headach, and pain in the orbits ; the patient complains of a sense of compression, as if a cord was bound tightly round the head. The conjunctivæ become injected, and the eyes watery ; throbbing in the temples, with intolerance of light and noise. The face is flushed, and frequently a slight puffiness, or swelling of the eyelids, is observed. The respiration is hurried, with a sense of fulness and oppression at the præcordia, and which the patient endeavours to relieve by sighs. The skin is hot and dry ; while on the face, neck, and breast, the perspiration appears in large drops. There is great thirst and general restlessness : the countenance appears agitated, and expressive of great suffering. The pulse is quick and hard,—from 100 to 120, often full and bounding, sometimes contracted and oppressed. The urine is scanty and high coloured : the tongue tremulous. During the first tumults of invasion, vomiting and straining sometimes occur, especially if the patient has been attacked soon after a full meal, or when the stomach is disordered. Vomiting, however, at this early period, is not an urgent symptom, and in very many cases, is not of more frequent occurrence than in the fevers of this country.

In this state of suffering, the first impulse is to relieve the more urgent symptoms, and for this purpose, bloodletting is usually employed with some temporary advantage. As an impression is made by this evacuation, cases are not often met with, in which we can observe the consequences of the disease being left to

pursue its own course ; yet a few examples of this kind occurred. Men who were employed at the Admiral's Pen, or who had left their boats and remained at Kingston, were sometimes taken ill in the evening, or during the night, and before they could be visited, or sent to the Hospital, many hours had elapsed. In a few cases of this description, the patient was in a state of somnolency, or stupor, and from which it was difficult to rouse him : the pulse was slow, or not exceeding the natural frequency, and intermitting ; the head rolled from side to side on the pillow ; the countenance was tumid, and inanimate ; the eyelids half closed ; eyes dull and heavy, or wild and staring ; pupils dilated. In one case, in which the patient was attacked with violent convulsions, and died within fifteen hours from the attack, one pupil was much dilated, and the other contracted to a mere point. The tongue was white, smooth and moist,—it appeared to be somewhat swollen, and bore the impressions of the teeth. Over the trunk the heat was natural, —the extremities cool,—the skin clammy. When the more severe symptoms have been relieved by active treatment, the skin relaxes, and the pulse is reduced in force and frequency : this remission, however, is only of temporary duration ; the frontal headach and pain in the orbits return, with a succession of paroxysms, and intervals of comparative ease. There is generally a marked exacerbation of the symptoms in the evening.

About the third day, the pulse is generally firm and contracted, but it differs in different cases, and even in the same individual at different times. The headach and general pains now become less distressing : the heat does not in general much exceed the natural standard, but sometimes rises a little during occasional febrile flushes.

The tongue also varies, sometimes it is whitish and smooth, but more frequently furred, with a brown streak in the centre, red at the edges, and tremulous. About the fourth day, or earlier, the countenance changes, the eyes become dull, with a yellow tinge of the conjunctiva: large yellow patches now appear on the neck and chest; but very frequently the yellowness is general, and the skin gradually assumes a deeper tint; while in some cases, it does not appear until after death. Occasional vomiting now occurs, but without much straining, and there is a sense of oppression at the *præcordia*, with frequent sighing: the memory is defective,—the mind wavering and unsteady. A papular eruption now frequently appears about the upper lip, angles of the mouth, and *alæ* of the nose, containing a whitish coloured lymph, which becomes sero-purulent, and forms dry crusts. If these crusts are removed, or the cuticle broken by the fingers of the patient, a slight oozing of blood takes place.

The majority of the cases treated in the Hospital at Port Royal, were not sent from their ships at the commencement of the disease, although the orders of the Commander-in-Chief were imperative on this point. On the third or fourth day of the disease, three or four patients would be packed into a jolly boat, at the hottest period of the day,—the marines dressed in red jackets, black caps, and accoutrements; detained, perhaps, in the boat alongside the ship for some time, and often obliged to sail half way across the harbour, and make a tack to reach the wharf, these men were received in a state of great exhaustion. They had been treated by copious and repeated venesection, drastic purgatives, and calomel in doses of a scruple, or half a

drachm every four, or six hours. Some, in whom the head had been chiefly affected, were in a comatose state; and others were in a state of great prostration, with frequent vomiting, some with black vomit; and it was evident, that the only object of removing them, was to prevent them from dying on board. Remonstrance against this practice was made in vain.

About the fourth or fifth day, when the febrile action has subsided, there is frequently a perfect exemption from pain, the pulse does not exceed 70 or 80, if the patient is at rest; the heat natural, and skin moist; the tongue whitish, moist, and tremulous. The patient will get out of bed if not prevented, dress himself, and walk out of the ward. A medical man, unacquainted with the insidious nature of this disease, would immediately pronounce the patient convalescent, and more than one Surgeon, on his first visit to the Hospital after arrival from England, expressed the greatest surprise and incredulity, on being informed that the patient would not survive twenty-four hours. A medical officer, the Assistant Surgeon of a Packet, continued three days in this state of deceitful calm. On finding him in the balcony dressed, and seated in a chair reading a newspaper, I urged him to go to bed, which he did with much reluctance, and assured me that he had no complaint except weakness; yet black vomit appeared two hours afterwards, and he died the same evening. In this "fatal lull" as it was usually termed, the step is unsteady, the pulse hurried on exertion; the mind wavering; the countenance dejected; with flatulence and occasional hickup.

During this stage of the disease, great variations are observed in the state of the pulse: in some, it is found

to vary but little from the natural state, yet when examined an hour afterwards, it will be full and jerking, or intermitting. The patient now becomes delirious; the tongue and teeth encrusted; the body exhales a cadaverous odour; and if part of the bed clothes happens to touch the wall, or floor, myriads of small red ants issue forth from the crevices, and commence their depredations. The heat of the body is now reduced below the natural standard; and in some cases, below the temperature of the atmosphere. A thermometer with a projecting bulb, placed in the axilla, sunk to 83° Faht., while the temperature of the air in the ward, and without, was 85°. The temperature in the mouth was frequently observed to be some degrees below the natural heat of the body in health; and this was attributed to the feeble power of generating heat, and to the cooling effects of evaporation from the surface. In this state of prostration, with occasional vomiting of coffee coloured fluid, with a slight oosing of blood from the gums, nose, and lips, from a blistered surface, or wherever there is an abrasion of the cuticle, the patient will continue for some days. The pulse is slow and weak. In one case, in which the heat of the body was below that of the air, the pulse varied from 50 to 56, during the space of ten hours,—weak and undulating, and arrested by very slight pressure upon the artery; yet, even from this hopeless state, recoveries take place.

As the powers of life sink, the patient becomes insensible for some hours before death. In other cases, he dies suddenly in making an effort to vomit, or to turn himself in bed. The black vomit, which constitutes a somewhat singular feature in this disease, seldom appears before the third day, or until the febrile action

has subsided. The matter ejected is at first a turbid watery fluid, differing in colour, according to the nature of the drink, but gradually becoming darker. The matter resembling the grounds of coffee, is not, strictly speaking, black vomit. That fluid is of a black colour, and after being allowed to remain at rest, a quantity of mucus is deposited, and adheres to the sides and bottom of the utensil ; on pouring off the fluid part, the mucus appears as if mixed with small grains of gunpowder. When large quantities of this fluid are brought up, the mucus is less abundant, and the black matter subsides if not agitated. In some cases, the black vomit does not appear during life, yet after death, the stomach is found filled with this fluid. It is brought up by a jerk, or slight convulsive effort, without any straining.

I may here mention a somewhat singular fact which, as far as I am aware, has not been observed by others ; viz., the existence of the matter of black vomit in the stomachs of those who died from other diseases than fever. A marine, invalided at Barbadoes, was sent to Jamaica Hospital to wait for a passage to England : he was in the last stage of Phthisis, with purulent expectoration, hectic paroxysms in the evening, and diarrhoea. On the fourth day after admission, he complained of general indisposition, and loss of appetite : the tongue was clean, and there were no symptoms indicative of any other disease than the affection of the chest. In the evening, he brought up a small quantity of black vomit, became delirious, and died the following morning. On dissection, the stomach was found to contain about a pint and a half of this fluid.

In a case of Psoas Abscess, sent to the Hospital in the last stage of hectic fever, the patient died on the

seventh day after admission, from mere exhaustion, and the stomach was filled with black vomit, although none appeared during life.

It was before remarked, that the symptoms are modified to a certain degree, by the age and constitution of the patient. In the bilious temperament, as characterized by black hair, a dark skin, and moderate developement of the muscular masses, the headach and other symptoms are equally severe in the first stage of this fever. The sense of heat, and tenderness at the *præcordia*, are more distressing: the pulse is less expanded,—generally hard and contracted; the heat more pungent, and the skin harsh to the touch: yellowness of the skin, and irritability of the stomach, occur at an earlier period, and the matters ejected are often of a yellow, or bilious appearance. The ratio of mortality is higher among individuals of this temperament, than among those of the more purely sanguine.

In the phlegmatic temperament, characterized by a pale, soft, and greasy skin, with predominance of the adipose and lymphatic systems, the febrile action is more moderate. Although the headach may be equally severe, the pulse is less expanded, and more sluggish. In some cases, the heat is but slightly increased, and there is a low creeping pulse. The countenance is bloated and inanimate, and the eyes are dull; the tongue is somewhat swollen, white and smooth; the bowels generally torpid. The patient lies in a state of torpor, or somnolency, and is indifferent to surrounding objects. The vital energies seem incapable of excitement, and coma succeeds. In some of these cases, it was observed, that the body retained its heat for an unusually long period after death.

In a disease attended by symptoms of such severity, the rate of mortality is at all times great; during its progress, however, certain symptoms sometimes occur, as it were accidentally, and which may be regarded as efforts of nature to relieve herself. These crises appeared to be the result of local determinations of blood to, or irritation of, particular organs, and to act upon the principle of revulsion. In a number of cases that recovered, a papular eruption appeared on the lips, and alæ of the nose, and desquamated in crusts. In three, a copious discharge of turbid bloody urine took place, one on the third, and two on the fourth day, when the irritability of the stomach subsided, and the patients did well. In five cases, in which a dysenteric purging took place, with a considerable quantity of coagulated blood, four recovered. In six cases, where the patients lay in a state of somnolency, almost approaching to coma, a slight hemorrhage took place from the nose, and five became convalescent. In three instances, inflammation and suppuration of the glands in the groin and axilla took place, and the patients recovered. An eruption of small florid spots on the extremities appeared to be a favorable symptom. In a few cases, in which several small boils occurred, the disorder terminated favourably.

## SECTION II.

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### APPEARANCES ON DISSECTION.

DURING the progress of a disease attended by pain, or uneasy sensations, in any particular part, and particularly when accompanied with heat of the skin, and a quick pulse, the existence of inflammatory action is always suspected. From the severity of the symptoms attending this fever, and the rapidity of its progress to a fatal termination, inflammation seems to have been considered necessary to account for the phenomena. On proceeding to a post mortem inspection, therefore, we commence with an impression on the mind, that some deviation from the healthy state will be found in the organic structure. If marks of increased vascularity are observed, we are but too apt to conclude, that they are either the cause, or the consequence, of diseased action during life. In this manner, a degree of importance is often attached to particular appearances, which they do not merit; and inferences drawn, that are founded on misconception and error. Whatever may have been the cause of death, certain appearances are observed in the dead body, which originate during the last struggles of life—from the gravitation of the blood to the most depending parts, or from both these causes combined. Very frequently, indeed, the post mortem

appearances are not sufficient to account for the symptoms during life.

As the appearances observed in the bodies of those who have died of this fever are similar, I shall endeavour to describe their nature, comparing them with what we observe in other diseases of a very different description, and offer some observations on the legitimate inferences to be drawn from them. Where the head had been chiefly affected, and the patient was in a comatose state for some time prior to death, the appearances observed were indicative of increased determination of blood, or preternatural fulness of the vessels. The dura mater was more vascular than usual, the minute branches of the arteries being injected, while the larger branches were empty; the external surface of the membrane was often smeared with blood, evidently proceeding from the rupture of small vessels by forcibly tearing off the calvarium. This, however, was immediately washed off by a sponge: no deposition of lymph was ever observed, or other marks of inflammatory action, such as appear in inflammation of this membrane produced by external violence. On examining it with a magnifying glass, and comparing it with the same membrane in another subject, where no affection of the head existed, the minute arteries were more injected.

It may be remarked, that appearances are sometimes described as marks of disease, which in reality are not so. Those granular or fatty deposits on the external surface of this membrane, are the glandulæ Pacchioni, which are lodged in corresponding depressions in the bone; and the degree of firmness with which the dura mater adheres to the bone, cannot be regarded as a mark of disease. On dividing the dura mater from the occiput forwards,—

separating the falx from its attachment, and turning it backwards, attachments are found to exist on each side, along the course of the longitudinal sinus, which are sometimes considered morbid appearances. These adhesions, however, are perfectly natural, and are formed by the veins of the pia mater terminating in the sinus. On the upper part of the lateral lobes, on one, or both sides, the dura mater is frequently found adhering to the subjacent membranes ; the uniting medium is a whitish substance similar to medullary matter, but firmer ; and this is also sometimes described as disease. I have found these adhesions in several cases of Phthisis, where no affection of the head existed,—in a man who was brought to Jamaica Hospital dead, from hemorrhage caused by the bite of a shark when bathing. In two cases of Pneumonia, one of which terminated in gangrene of the lungs—in two cases of Erysipelas Phlegmonodes—and in many other instances.

On turning back the dura mater, the hemispheres are brought fully into view, and numerous veins, filled with black blood, are observed running between the convolutions of the brain, with a slight effusion of serum between the tunica arachnoidea and pia mater. On puncturing the former membrane, a few drops will flow out, but it appears to be confined in a delicate cellular tissue between the membranes. On carefully raising the arachnoid membrane, it appears to have lost its natural transparency and is slightly opaque, or clouded. This is also apparent on inflating it with the blow pipe. The pia mater is more vascular than natural ; on comparing it with the same membrane in a person who died suddenly, from a rupture of an aneurism of the abdominal Aorta, the minute arteries were more injected, and the

membrane was less transparent; still there was no bloodshot appearance apparent, which is observed in inflammation of the membrane produced by external injury. It was also observed, that in all cases where sub-arachnoid effusion existed, there was more or less effusion into the ventricles.

On cutting through the medullary substance, minute bloody spots presented themselves, especially if the examination was made within two or three hours after death. When the examination was longer delayed, this was less apparent. No induration, softening, or other change in the structure of the brain, were ever observed. The ventricles always contained more or less fluid,—six drachms have been collected. The plexus choroides was generally turgid, and in one case, a small clot of blood was found in the left lateral ventricle. At the base of the brain, the veins are always full of black blood, and more or less serum in the base of the cranium and spinal canal,—four ounces have been collected. This congestion of the vessels at the under and posterior part of the brain, is to be attributed, in a great degree, to the gravitation of the blood after death.

In other cases where, after the third day of the disease, the head was but little affected, no very obvious marks of disease could be observed, either in the brain or its membranes. The brain of a patient who died of Phthisis, and of another who died of fever, were minutely examined by myself and assistant, and after comparing them, we were unable to ascertain the body to which each belonged. In some of these cases, it is probable, that the increased vascularity of the membranes is relieved by the effusion of serum, in the same manner as in dropsical effusions into the thorax and abdomen;

and that a degree of excitement, bordering on inflammatory action, may exist during life, of which dissection after death affords no proof.

With the view of ascertaining the state of the spinal cord, it was laid open from the occiput to its extremity, and its investing membranes minutely examined. On the posterior part, the veins of the pia mater were found to be full of black blood, and there was a reddish blush along the centre of the cord, while anteriorly, this was less apparent. To ascertain how far this might be the effect of position, another body was placed upon the belly, and the same vascular appearance was observed on the anterior part of the cord. This was repeated four times, and with the same result. It appears, therefore, that these marks of increased vascularity in the spinal cord, are produced by the gravitation of the blood after death.

**THORAX.** The appearance of the viscera in this cavity is modified by the state of the respiration before death. If the respiration has been laborious, the ascending and descending cava, and also the auricle, are found distended with black blood, and this distension of the venous system extends throughout all the great cavities. The pulmonary veins were filled with black blood, and the auricles and ventricles of the heart contained amber coloured coagula. The lining membrane of these cavities frequently presented a reddish brown tinge, but it was merely a stain, and was partly removed by washing. Portions of this membrane when carefully dissected off, were smooth, shining, and elastic.

**THE LUNGS**, anteriorly, generally presented a healthy appearance, and posteriorly, were in a state of engorgement, evidently the effect of position.

**ABDOMEN.** On laying open this cavity, the veins appeared full of black blood; and this was more particularly observed in the under or most depending parts, where the intestines had acquired a livid colour. On applying a ligature to the lower part of the oesophagus, and to the upper part of the duodenum, and removing the stomach, it was found to contain more or less of the matter of black vomit—sometimes only a few ounces, at other times a quart. On laying it open, the following appearances were observed: about the cardiac orifice, the mucous membrane was of a red colour, extending along the smaller curvature, with evident marks of injection of the small vessels. In many cases, there were numerous florid patches, presenting the appearance of ecchymosis, and the colour was always deepened by exposure to the air for a few minutes. This was considered by several medical officers, who were present at these examinations, to be decided marks of inflammatory action; yet, on dissecting off the mucous coat at this part, it was found to be firm and elastic; the subjacent cellular tissue, connecting it with the muscular coat, was also injected, but there was no thickening of these membranes, or deposition of lymph, the products of inflammation in ordinary cases.

Over the greater curvature, the mucous coat was of a dirty grey, or yellowish colour, with red patches interspersed, covered with viscid mucus, and portions of black vomit—soft and easily lacerable with the handle of the scalpel, and admitting of being peeled off in shreds: these separated portions presented, on the attached surface, minute brown spots, as if from the rupture of vessels: the subjacent delicate cellular tissue was traversed by a few small vessels of a brownish colour.

In some cases where the stomach was nearly empty, the mucous membrane was gathered into folds, traversed by rents, showing the muscular fibres beneath, and conveying the idea, that the muscular coat had been forcibly extended, while the less elastic mucous coat had been torn.

In a few cases, the stomach presented a different appearance, the coats were extremely attenuated: the mucous coat over the great curvature had been dissolved, the muscular coat also was softened, had nearly disappeared, and was reduced to a pulp by rubbing it with the point of the finger, leaving only the peritoneal coat entire. On referring to memoranda, I find that, in two of these cases, the patients died at night, and the bodies were not examined until the morning, after an interval of ten or eleven hours. On a careful examination of the tunics, where they began to pass into this state of disorganization, no thickening, or any other mark of increased vascularity could be detected. On minutely examining the small black points on the mucous surface, they were found to consist of minute portions of the matter of black vomit, in the mouths of the excretory ducts of small mucous glands. On collecting a portion of it, it was impalpable between the fingers, and bore a strong resemblance to the black matter in the bronchial glands, with which it was compared, and both evidently consisted chiefly of carbonaceous matter.

THE INTESTINES often presented a livid appearance, especially in the most depending parts, with congestion of the veins: the internal tunic was commonly softened, and admitted of being rubbed into a pulp between the fingers. The contents of the alimentary canal were of

a greenish black colour, and frequently the black vomit could be traced through the whole course of the canal. According to certain French authors, this softening of the mucous membrane of the stomach is attributed to chronic inflammation, but to this opinion I cannot subscribe; as after the most minute examination of the parts, I have never been able to discover any of those marks, which are so characteristic of inflammatory action in other mucous membranes. Those, indeed, who have been in the habit of making post mortem examinations, must be well aware, that similar appearances are observed in almost every dead body. These red coloured, or livid patches; the injected appearance about the cardiac orifice; and the softening of the mucous coat, were found three hours after death, in the stomach of a seaman who was killed by a fall from the mast head: when this was shewn to a medical officer present, who had made many dissections in fever cases, he expressed his surprise at the appearance; and declared that, if he had not known the cause of death, he would have considered it to be the stomach of a patient who had died of fever.

In our numerous dissections in this Hospital, the mucous membrane of the stomach in those who have died of Fever, Phthisis, and many other diseases, presents the same appearance. I have more than once taken the prescription ticket of a yellow fever case, with the appearances on dissection detailed, and found the description exactly apply to the stomach in Phthisis. This was pointed out to the Assistant Surgeons, and by omitting the words "black vomit" the description was copied verbatim. We are, therefore, irresistibly led to the conclusion, that it is impossible these appearances can be the result of inflammatory action, in so many

diseases essentially different in their nature: and that, as they are nearly similar in almost every body we examine, they must be attributed to some common cause. It is highly probable, that this cause is more simple than commonly supposed. For some time prior to death, the vital actions are so far enfeebled or destroyed, that the coats of the stomach and intestinal canal, lose the power of resisting decomposition; and when we take into consideration, that these tissues consist almost entirely of gelatine and albumen, the softened and dissolved appearance may, perhaps, be more justly attributed to maceration, together with the solvent properties of the fluids to which they were exposed.

**SPLEEN.** The appearance of this organ varied; frequently it was perfectly natural; in other cases, it was increased in size, of a pale colour, soft, and easily broken down by the fingers: sometimes it resembled a mass of coagulated blood. It is questionable whether these varying states of this organ had any connexion with this fever, as the same appearances are observed after death from various other causes.

**THE LIVER** was generally healthy in structure: different degrees of engorgement of the veins were observed, and it was sometimes of a deep yellow tinge. But those slight variations in colour and consistence, are very generally met with after other diseases. Sometimes the gall bladder contained a moderate quantity of healthy looking bile; in general, however, the bile was of a dark colour, resembling tar in consistence: its colouring property was unchanged, as a small portion always communicated a yellow tinge to a large quantity of water. The ducts were frequently examined through-

out their whole extent, but without observing any deviation from the healthy state.

**BLADDER.** In some cases, the internal surface exhibited marks of increased vascularity, or was studded with florid patches, but in every case in which this was observed, blisters had been applied. The kidneys were healthy: in three cases, in which turpentine had been administered, the glandular structure appeared redder than usual—the papillæ distinctly so; and in one, a coagulum of blood of the size of a nutmeg, was found in the pelvis of the left kidney. In the course of these examinations, whenever yellowness of the skin existed, the cellular and adipose tissues were found of the same colour throughout the body.

The appearances above described were noted in the dead house, and immediately inserted in the prescription tickets containing a detail of the symptoms, which were transmitted to the Medical Commissioners, together with the quarterly reports. Copies of these tickets, by dozens, are now before me: and after a careful re-perusal of these observations, written at Port Royal fifteen years ago, I have not found it necessary to make any additions; but in several instances, have endeavoured to condense.

It is inferred, therefore, from the above considerations, that the yellow fever of Jamaica is a disease of the whole system, in which every organ is more or less affected; with local determinations of blood to particular parts, succeeded by congestion of the vessels; that the tumultuous actions of the nervous and vascular systems exhaust the vital energies, arrest or suspend the secretions, and but too often terminate in the death of the patient.

## SECTION III.

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### METHOD OF TREATMENT.

IN the preceding sections, fever has been considered as a general affection, and to consist of a series of symptoms indicative of a disordered state of the nervous and sanguiferous systems, attended with a corresponding derangement of the secretions. In the first days of the disease, these symptoms indicate an increase of vitality, or a state of general excitement throughout the system. In a more advanced stage, debility properly so called, succeeds, which is characterized by a loss of energy of the powers of life, or of those actions which tend to restore the equilibrium, and terminate in the actions of health. The only rational mode of treatment, therefore, consists in the adoption of such means as seem best calculated to arrest, or suspend, those tumultuous actions at the commencement of the disease, and, at a more advanced period, to obviate, or remove their effects. Such, however, are the varying forms and conditions of disease, that we often find it a difficult task to fulfil these indications.

In the treatment of this fever, the greatest diversity of opinion prevails, arising, it would appear, from the theoretical views entertained of its nature. According

to some, it is a highly inflammatory disease, for which bloodletting is considered the sole remedy. Others, again, place their reliance upon Mercury; and assert that, as soon as the system is brought under the influence of that medicine, the disease is cured. Others adopt a middle course, and combine the antiphlogistic and mercurial methods of treatment. Others, again, bleed with caution, and place their chief dependence on purgatives, cold affusion, &c. If the patient be subjected to active treatment during the early stage of the disease, much may be done to arrest its progress: but after the second or third day, the opportunity has passed, and all remedial measures are but too frequently ineffectual.

When the patient was received into Hospital at an early period of the disease, and before any treatment had been adopted,—when the headach and general pains were urgent, and the febrile symptoms fully developed, bloodletting was immediately had recourse to: the quantity drawn was regulated by the effects produced, the blood being permitted to flow, until the headach and general pains were relieved—the skin became relaxed,—the force and frequency of the pulse reduced, and vomiting, or faintness, induced. In the course of an hour, or after recovering a little from the shock, the patient was carefully examined; and if the pulse had again become hard, with a return of febrile action, headach, or feelings of uneasiness, blood was again drawn according to the urgency of the symptoms. The patient was now immersed in a bath of the temperature of 90° to 96° Faht., and the surface thoroughly cleansed by frictions of flannel cloths and soap. This process was completed as soon as possible, when the patient was dried by

wrapping him in a sheet previously warmed at the fire, and placed in bed, with the least possible exertion to himself.

The quantity of blood drawn varied in different individuals, the necessary effect being produced by the loss of a moderate quantity in some ; while in others, the abstraction of a much more considerable quantity was required. The object was to make a decided impression on the system, and this depended, to a certain extent, upon the position of the patient during the evacuation : if placed in the recumbent posture, a very considerable quantity may be drawn off before faintness is induced, while after the loss of twenty ounces, by raising the head and shoulders, retching, and faintness will follow. The loss of from twenty to forty ounces, by one or two bleedings, was generally sufficient to arrest, for a time, the febrile action ; but in some cases, where the patient was of a robust and plethoric habit, ninety ounces have been abstracted within eight hours, and followed by speedy convalescence. After being removed from the bath, and comfortably disposed in bed, a purgative was administered, consisting of five or six grains of calomel, with eight or ten of the compound extract of colocynth, or twenty grains of jalap in the form of a bolus, and an action maintained on the surface by mild diaphoretics, and warm diluents. When the subject was favourable, and this practice fully carried into effect, the progress of the disease was, in many cases, speedily arrested, and the recovery was rapid.

In others, however, the result was less fortunate ; although the more urgent symptoms were relieved, the giddiness on getting out of bed, the general uneasiness, the heat of skin, quickness of the pulse, and nausea,

indicated that the disease was not subdued. In these cases, the application of leeches to the forehead and temples, or the abstraction of ten or twelve ounces of blood from the arm, afforded relief. When the skin was dry and harsh, immersion in a warm salt water bath of about 96°, containing a handful of mustard, and the body well rubbed with flannels, often afforded relief, more especially when an action was excited on the surface. With the view of avoiding any exertion on the part of the patient in getting into the bath, frictions with liniment of ammonia over the trunk of the body were employed. In a few cases, the vapour of carbonate of ammonia was used. It was produced by placing a drachm or two of the carbonate in coarse powder, in a heated iron cup placed under the bed clothes, which were raised a little by a cradle, and tucked in round the neck.

In many cases, in which the headach continued, and when the farther abstraction of blood from the arm was hazardous, relief was obtained by shaving the head, and applying a piece of linen wetted with cold water, and this may be used from the very commencement of the disease. The drink consisted of water artificially cooled, barley water, weak lemonade, or effervescent saline draughts, at intervals. By wrapping bottles of water in a piece of old linen, and placing them in the shade in a current of air, the temperature was frequently reduced to 50°, by the evaporation from the surface, and was extremely grateful to the patient. By dipping a piece of linen in this cold water, and applying it to the forehead, a slight rigor would sometimes succeed, and the febrile heat throughout the body be speedily reduced. The bowels were kept freely open by laxatives; frequently

two or three grains of calomel, twenty grains of the compound powder of jalap, or a seidlitz powder, given in the act of effervescence.

Finding that the only chance of benefit from medical aid, depended upon arresting the series of febrile actions by the prompt application of active remedies ; the use of tartrate of antimony was adopted in forty-two cases, and evidently with beneficial effects. As the exhibition of antimony, and other nauseating medicines, in the fevers of the West Indies is generally reprobated, it may be necessary to state the circumstances under which it was administered.

After an impression had been made on the system by a full bleeding, and the use of the bath, five or six grains of calomel, and a grain of tartrate of antimony, were exhibited in the form of a pill, followed up by two or three drachms of the sulphate of magnesia. Temporary depression, vomiting and purging, were soon induced : the stomach was relieved of a quantity of undigested food, and a profuse perspiration ensued. At the end of an hour or two, the patient would express himself greatly relieved,—would fall into a sound sleep which continued for hours, and awake free from complaint. In some cases, where the excitement had not yet taken place, the pulse being feeble and the skin cool, the warm bath, followed by a grain, or a grain and a half, of tartrate of antimony, and in one case, ten grains of the sulphate of zinc, before vomiting was induced, and afterwards a purgative, had the effect of arresting the disease, convalescence being established in twenty-four hours. That irritability of stomach, which has been considered characteristic of this fever, was not found to be more frequent or distressing during the first stages, than in the fevers of other

countries; and in some cases where vomiting occurred spontaneously, it appeared to be produced by the irritation of undigested food in the stomach, and the patient was relieved.

The tartrate of antimony, it must be observed, was never given later than twenty-four hours from the first attack: and after carefully watching its effects, no inconvenience was ever observed to arise from its use. On the contrary, when preceded by bloodletting, administered with caution, and with a due regard to the circumstances of the patient, it proved a valuable auxiliary in arresting febrile action. The intention of putting the system under its depressing influence, was to suspend the stage of excitement, and promote an action on the surface: and these desirable objects it was found capable of effecting, without producing the subsequent debility which necessarily results from the repeated and excessive abstraction of blood,—without any danger of inducing that excitement often produced by loss of blood, and which, to a superficial observer, might seem to render the repetition of venesection necessary. The cases in which the tartrate of antimony was given were severe. Sixteen had been bled twice within six hours to the extent of, from twenty-six, to fifty ounces. The others had been bled once; and the greatest quantity drawn, was thirty-two ounces. The number of deaths was five, being nearly 1 in  $8\frac{1}{2}$ .

During the fever of 1828, after the more urgent symptoms had been relieved by venesection, cold affusion was employed when the skin was dry, and the heat above the natural standard, and with temporary benefit, but its effects were transient. Sponging the body occasionally with tepid water, and the application of

cloths dipped in cold water to the head, appeared to produce the same beneficial effects, and with less fatigue to the patient. After the bowels had been thoroughly cleared, mercury was given in five grain doses, combined with antimonial powder and opium,—sometimes in doses of a scruple twice a day, and also by inunction, with the view of exciting ptyalism. In many cases also, where this medicine had been given in large doses, for two or three days before the patients were sent to the Hospital, it was continued, with the effect of producing a slight rawness, or soreness of the gums, but, with occasional exceptions, without that fætor of the breath and increase of the secretions, which characterize the beneficial effects of this medicine in some other diseases: and it was found impossible to produce ptyalism by increasing the dose. When given from the commencement of the disease, and during febrile action, it was difficult to affect the gums. They would assume a whitish appearance, and instead of being swollen, appeared rather contracted, and separated from the teeth. It was observed that, in those cases in which the tartrate of antimony had been given, the gums became affected at an earlier period, than in those who had been taking mercury in much larger quantities, and this was attributed to the absorption of the medicine being promoted, by the operation of the emetic and nauseating properties of the antimony.

To promote ptyalism, the arsenical solution, sulphate of quinine, oil of turpentine, and wine, were given in conjunction with calomel, but with very questionable utility. In some cases, it was quite evident that the stomach was rendered more irritable. On a comparison of several cases, in which calomel had been employed

merely as a purgative, with others in the same ward, in which it had been given in larger doses with a view of producing ptyalism, the restlessness and irritability were generally more conspicuous in the latter; and it appeared to act injuriously, by creating a degree of irritative fever, which was superadded to that already existing. In several cases in which ptyalism took place, the patients recovered, but the convalescence was protracted, in some it came on suddenly, and was succeeded by troublesome ulcerations of the tongue and mouth, accompanied by hemorrhage from the gums. In others, again, who were fully under the influence of the medicine on the third day, the disease ran its course, and terminated in black vomit, and death. It appears, therefore, that in the open forms of this fever, the mercurial plan of treatment is, perhaps, not more efficacious than others; and that, when that medicine is given indiscriminately, it is often not only useless, but injurious.

In those forms of fever, in which there is a deficiency of excitement, or a torpor of the nervous and sanguiferous systems, calomel and opium were often exhibited with apparent advantage; purgatives, however, were generally combined, and very frequently the oleum terebinthinæ in the form of draught, and also by Enema.

It has been asserted, that if a person be kept under the influence of mercury, it will prove a protection against this fever: this has been proved to be fallacious in several instances. Men who were under treatment for syphilis, were attacked with the prevailing fever, even when under the influence of mercury, and died of black vomit; one man, on whom ptyalism was brought on, by frictions with camphorated mercurial ointment

on the scrotum for an enlarged testicle, was attacked with fever and died. Another was salivated after taking twenty grains of Pilula Hydrargyri, in doses of five grains night and morning. While the ptyalism was pretty copious, he was attacked with fever and recovered. In these cases it was observed, that the swelling of the gums, in great measure, subsided in the course of twenty-four hours.

When vomiting, and a sense of heat at the epigastrium existed, blisters were frequently employed, but without any material relief. When the head was chiefly affected, and the patient in a state of coma, blisters to the head, and nape of the neck, appeared to be beneficial; but in the advanced stage of the disease, an oozing of blood was apt to take place from the vesicated surface.

In the more advanced stage, sulphate of quinine, diluted sulphuric acid, nitric, and sulphuric æther, opium, and carbonate of ammonia, camphor, oleum terebinthinae, and capsicum, were exhibited singly, and in different forms of combination, but without any very obvious advantage, and sometimes they appeared injurious by inducing vomiting. The acetate of lead, in grain doses, with ten drops of tincture of opium, in the form of a draught, every four or six hours, appeared useful in allaying gastric irritability. Nitrate of silver was employed in grain doses with the same intention, also hydrocyanic acid, and apparently with advantage.

Certain native remedies, said to possess great virtues in allaying vomiting, were also tried. Adrue, (*Cyperus Articulatus*) was given in the form of Infusion, and was a warm aromatic bitter. Antidote Cocoon (*Feuillea Cordifolia*) the seeds are intensely bitter; they

were given in the form of tincture, which was prepared by infusing the bruised seeds in proof spirit, with a little orange peel. These medicines produced no apparent benefit.

In the advanced stage of this fever, it appeared to be a matter of indifference what medicines were prescribed ; and active treatment, in this enfeebled state of the nervous and vascular systems, would only hasten dissolution. The great object was to maintain the heat of the body by external warmth, and by the free use of brandy, wine, and porter. When the extremities were cold, the pulse feeble, the skin cold and clammy, with an oozing of blood from the gums, heat was applied to the extremities by means of warm blankets, or small bags about half filled with warm sand, or bran : by placing these bags under the limbs and others over them, a uniform heat was maintained. Brandy and water, wine, or brisk bottled porter, were given at intervals, with small quantities of nourishment, as beef tea, arrow root, or sago. Under this treatment, patients sometimes recovered from a state of extreme prostration, in which every symptom seemed unfavourable.

The quantity of spirits and wine used in some of these cases was considerable, a pint of brandy, and a bottle of porter, were frequently consumed daily ; or a bottle of wine, in the form of drink and warm negus. Bottled porter was generally relished, and two bottles were frequently taken daily, without materially affecting the pulse, or increasing the heat of the body. In one case, eighteen ounces of brandy, and a bottle of porter, were consumed daily for three days in succession ; the pulse was at 60, and feeble ; on the second day, it was at 65, and on the third day, at 70, somewhat fuller, but still

weak; repeated small doses of opium were given at intervals, with sulphate of quinine and capsicum. In some of these cases, quinine, carbonate of ammonia, and camphor, appeared injurious by exciting vomiting, while brandy, wine, or porter, were retained, and excited a glow of warmth over the body.

During convalescence, as the appetite returns, the greatest care should be taken to proportion the quantity of food to the power of assimilation. If the patient indulges in too much animal food, the stomach is oppressed, nausea and vomiting excited, or a troublesome diarrhoea succeeds, and the recovery is retarded. For the first three or four days, when there is a craving for food, a basin of soup, or a little fish, may be allowed for dinner; the wine, or other stimulant, that may have been necessary during the extreme prostration, should be gradually withdrawn, and strict attention paid to the bowels. When sufficiently recovered to undertake the journey, the patients were landed in the cool of the morning, on the opposite shore at Greenwich, and conveyed in a spring waggon to the mountains, for a change of air. As the last mile of the journey, however, had to be performed on saddle mules up a steep ascent, the Convalescent Hospital was only accessible, at a period when the change was of less consequence.

With the intention of giving convalescents from fever, the benefit of a change of air, it had been customary to send them to sea on a cruise, but the propriety of this was very questionable. In small vessels, there is no accommodation for the sick; and as there is a total want of those comforts which an Hospital affords, this practice was discontinued.

I may here allude to an opinion entertained by some,

that this fever occurs only once in the same person ; and that one attack constitutes a complete immunity from the disease, however long the individual may remain on the station. This opinion is unfounded ; as instances occurred of the same individual being attacked twice within three months. This was observed in men belonging to the Magnificent, who had been previously in the Hospital, and were attacked when employed on board the Harlequin. On making enquiries among the patients, several were found who had suffered from fever at former periods, and been treated in the Hospital. On referring to the books, their names were found ; and one man came under my care, once in 1828, and twice in 1829. It must be admitted, however, that men who have already had an attack of fever, are much less liable to suffer from it again than new comers. If, however, they returned to England, and joined another ship ordered to the West Indies, they appeared to be as liable to suffer as those who had never before been on the station.

## SECTION IV.

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### CONTAGION.

FROM the unexpected manner in which this fever makes its appearance, and the ravages it commits among our seamen and soldiers, a variety of opinion has been entertained respecting the cause of these mysterious visitations. The influence of emanations from the soil has been already considered : and it now only remains to offer a few observations on contagion.

The opinion, that fever was propagated by the diffusion, through the air, of some noxious material generated in the bodies of fever patients, and that it was sometimes imported from other countries, was at one period pretty generally entertained ; and this belief led to the adoption of means to prevent the disease from extending into other localities. Experience, however, in many instances, proved that the disease was not to be confined within stone walls, or lines of circumvallation ; while in others, the means of prevention appeared to be efficacious, and the contagious nature of the disease was considered as fully established. This gave rise to a war of opinion, which led to endless discussion. One party drew his conclusions from what he considered

established facts ; while the other, doubted the facts, or denied the justice of the inferences drawn from them. It would be unprofitable to resume these discussions : to arrive at truth, the question must be viewed in a temper of mind free from bias ; and it is only by close observation, and a multitude of facts, that the contagious, or non-contagious, nature of this fever can be determined. From my own observation at Port Royal, I was convinced that the fever was not contagious, and that it originated rather from an acquired susceptibility, than from the intensity of any local cause.

The Magnificent, guard ship, would remain healthy for many months ; when, without any obvious cause, fever would appear among the ship's company, without being communicated to the other ships in the harbour. This ship was moored in a situation, where she was thoroughly ventilated by the land and sea breezes : she was never crowded ; her holds were kept perfectly clean, and white washed with lime. The casks of provisions kept on board, did not occupy one-twentieth part of the hold, and were arranged in such a manner as to admit of the free circulation of air, and it was quite impossible that any noxious material could be generated there. Many of the men were supernumerary seamen and marines, and they were much exposed to the sun when employed in boats, or on dock-yard duties. If there was a transport, or store ship to unload, a party of men from this ship assisted in landing the stores.

On the arrival of a ship in port, a constant communication was kept up with the Magnificent, even when fever was prevailing on board of her. The officers and men met at the dock-yard. Boats frequently came to the Hospital for medical stores, or with patients, and the

boats' crews would mingle with the patients, or go into the wards to visit their old shipmates : no person entertained an idea of contagion, and the ships would proceed to sea without a man on the sick list, and without a case of fever occurring.

In the Harlequin, fever appeared under circumstances, which might be considered as strong presumptive proofs of the existence of contagion. This ship, when her period of servitude had nearly expired, was found so defective as to render it doubtful whether she was in a fit state to cross the Atlantic. The Commander-in-Chief, having discovered the necessity of having a ship permanently stationed at New Providence, considered the Harlequin applicable for this service. A number of her men were taken out of her at Bermuda, and sent to England, and she was sent to Jamaica under convoy of another ship. After being several months in harbour, fever appeared, and a large proportion of her men were sent to Hospital. In this ship, there were, perhaps, some grounds for supposing that the fever originated from local causes, and was propagated by contagion, although nothing like positive proofs could be adduced.

She had been a considerable time in harbour before fever appeared, and the hold was said to be foul : yet, on making some allusion to the hold, the Commander-in-Chief informed me, that her hold had been cleared at Bermuda. Two Lieutenants, three Assistant Surgeons, the Purser, Master, and Clerk, who joined the ship in succession, were sent to the Hospital with fever, between the 26th of February and 10th of March, after being a day or two on board. Parties of men sent from the Magnificent to land the stores, and clear her hold, suffered severely, some of whom had been previously in Hospital

with fever. On visiting this ship, she was in charge of officers sent from the Magnificent; the orlop deck was in a filthy state; the ship appeared to have been forgotten; no person took any interest about her, and it was supposed she would be sold or broken up. Under these circumstances, discipline was out of the question; and drunkenness and irregularities prevailed to a considerable extent. The hold was cleared, yet the fever continued to attack every fresh victim who appeared.

In cases of this description, one party would immediately pronounce the disease to be contagious; and it would, perhaps, be equally difficult to prove that it is, or that it is not so. The non-contagionist, on the other hand, would attribute the disease to the ordinary causes operating upon men, who had already acquired a disposition to fever; and that it was excited into action by the laborious nature of the duties on which they were employed, and to mental despondency on seeing their comrades falling around them.

Under ordinary circumstances, there are no grounds for supposing that this fever either originates from, or is propagated by, contagion. Yet I am not disposed to assert, that it never can become contagious. It does not appear capable of being communicated by inoculation. On one occasion, I examined a quantity of black vomit in the palm of the hand, without thinking of a scratch I had received the day before, and which at the time was slightly inflamed, but no ill consequences followed. On a second occasion, I inoculated myself with black vomit on the back of the hand; the puncture festered, but healed in a few days.



## APPENDIX.

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IN a general statement of exposure to the air of the swampy soil of Batavia, at midnight, it may occur to the reader, that circumstances, not taken into account, may have operated in preventing injurious impressions. It may, therefore, not be superfluous to state under what circumstances this exposure took place; and also the nature of the experiments performed at Port Royal, before alluded to. The vessel in which I was returning from New South Wales, as a passenger, proceeded to Batavia for a freight, and lay at anchor in the Roads, about three miles from the shore. As there was no ship to be met with, proceeding direct to England, I remained in her, but frequently went on shore in the morning, and sometimes took walks of a mile along the foot paths, leading through a low swampy country covered with brushwood, for the purpose of collecting Botanical Specimens, and other objects of Natural History.

Occasionally meeting at Batavia, with a gentleman I had formerly known in the navy, and who then commanded a ship in the Dutch service, I left him one afternoon, between three and four o'clock, in perfect

health. About six o'clock the same evening he sent off his boat, manned by Malay seamen, with a request that I would visit him, as he had been attacked with Cholera, prevailing at the time, and was residing at the house of a merchant about five miles in the country. A strong breeze was blowing from the land, and it was half-past eight o'clock before we reached the Custom House; and nearly another hour passed away, before a carriage could be procured. In the mean time, I sat upon a log of timber, or walked about, and entered into conversation with the Dutch Officer of the Guard. It was half-past ten before I reached him, and he died within half an hour afterwards.

Being fatigued and thirsty, I took a glass of wine in a tumbler of water, and left the house. The coachman had got out of the way, or gone to sleep, and could not be found, I, therefore, mounted the box, with the Malay coxswain, and drove into Batavia, but it appeared that we had returned by a circuitous route. It was in descending the canal, near one o'clock in the morning, that I landed, and made the observations alluded to. Having wetted my feet in the swamp, and feeling cold and fatigued, on getting on board of the ship at two o'clock in the morning, I took about half a wine glass full of brandy mixed with water; but not being in the habit of drinking spirits at the time, it had the effect of preventing sleep, and producing headach.

During a second visit to Batavia, where I was detained upwards of two months, I was requested to visit the commander of a ship, who had been attacked with fever, and resided five or six miles in the country. On reaching him about nine o'clock, I partook of two small cups of coffee, and on leaving about half-past ten, a

glass of wine and water. At that time the Dutch were extending the banks, and raising from the bed of the canal, a vessel which had been sunk during the war, to prevent the passage of the English gunboats. A boom was thrown across at this place, and the ships' boats could not proceed farther. A number of Chinamen, and Malays, who were employed as labourers, lived in the jungle adjacent, in temporary bamboo houses. The boat's crew consisted of four active young seamen, two of whom had visited the Chinamen's quarters for the purpose of procuring spirits, but without success. I found the coxswain waiting for me at the Custom House, and on walking down the bank of the canal to the boat, nearly a mile distant, we entered the swamp alluded to.

The coxswain informed me, that during the evening they had some rain, and as the air was cold and damp, he walked to the town and procured a pint of rum, and some cigars, which were equally shared amongst them. The men were perfectly sober. On getting on board the ship, after sitting an hour inactive in the boat, I felt chilled, and my stockings were thoroughly wetted by the heavy dew in the grass. The stimulus I partook of on this occasion, consisted of a cup of warm tea, and a piece of biscuit, and no bad effects followed. The ship at the time was healthy, but fourteen days afterwards, a case of the Batavian fever occurred, and the disease spread rapidly. Out of twenty-eight men, seventeen were attacked, and four died, (one had been absent from the ship for two days, and was sent off in a comatose state.) The last man taken ill was the coxswain, who accompanied me into the swamp, twenty-nine days before, and he died. Another of the boat's crew had a slight

attack, and recovered. The two other men, and myself, escaped.

A few years afterwards, various attempts were made at the Naval Hospital at Port Royal, to ascertain the state of the air in confined situations. The ground floor of that building was about two feet and a half above the level of the sea, at high water, but there the rise and fall of tide is trifling. The soil consisted of shingle, and rubbish brought there to raise the ground, mixed with decomposing coral, which allowed the salt water to percolate through. The excavations under the floors were sunk to about the level of the sea, as before the flooring was laid in one of these wards, a little stagnant salt water was found in the centre. In another, the ground was very damp, and on scooping up the soil with a trowel, to the depth of nearly six inches, a little water had collected the following morning. A certain degree of ventilation was maintained under the floors, by three or four passages through the wall, on each side of the building, which sloped downwards. These apertures were about six inches square, and were covered externally by small iron gratings, which considerably diminished the area.

In one of the unoccupied wards, these passages were closed for three weeks, and an opening made in the floor, by cutting across two of the planks. Bottles of water were now lowered, and inverted, and brought up full of air. Considering it probable, however, that any noxious material existing in the air, might be soluble in water, and be washed away as it rushed through it, a quantity of air was drawn up from the other end of the ward, by means of a large syringe fitted with a tin tube, which was passed through a hole in the floor, and con-

fined in bladders for experiment. The space under the floor gave out no perceptible smell, although the windows of the ward had been shut in the morning. Lying down, and lowering my head through the aperture, a somewhat musty odour was distinctly perceived. A lighted candle burnt apparently with the same brilliancy as in the ward. One of the nurses (a black man) crawled round the excavation under the floor, and brought up two quart bottles, fitted with glass stoppers, full of air. He was in a state of perspiration, and described the air as hot and close. Another man went down provided with a candle, and being desired to observe if any chips or shavings were strewed about, returned with his cap full, and about as much more in the breast of his frock; these chips and shavings were a little damp, but no traces of decomposition could be observed, and the floor had been laid down ten months previously.

About the same time, I repeatedly walked to the Pallisades, at ten o'clock at night, and sometimes later, and sat for half an hour on the wharf near the burial ground, surrounded by mangroves, and patches of mud, and stagnant water. On these occasions, the land breeze was blowing from the mountains, and the thermometer was frequently observed at  $70^{\circ}$ ; but although dressed in cloth trowsers and coat, the sensation of cold was greater than might have been expected from the temperature of the air, as indicated by the thermometer; and this was attributed to the air being charged with moisture, and consequently, possessed of a greater power of conducting heat from the body.

In this neighbourhood six pits were dug, to the depth of from sixteen inches, to two feet, the earth being

prevented from falling in, by slates, or shingles, placed perpendicularly. A quantity of the leaves and twigs of plants growing near, was placed in the bottom of these pits, to the depth of about four inches, when pressed down by two or three stones placed upon them ; and any gazeous fluid that might be generated, was prevented from escaping, by covering them with small branches, and a handful or two of coarse grass, with a stone placed upon them, to keep every thing in its place. The leaves were taken from the following plants, viz.: *Rhizophora Mangle*. *Conocarpus racemosa*. *C. erecta*. *Coccoloba uvifera*. *Cassia alata*. *Jatropha gossypifolia*. *Moringa Zeylanica*, a handful of grass, and a slice of *Cactus Melocactus*.

At the end of a month, one of these pits was opened, and lying down upon the ground, I brought my face over it. The leaves were passing into decomposition, especially at the bottom, and gave out a peculiar earthy and mouldy smell ; but exactly similar to that perceived on turning over a heap of decayed leaves in other situations. About two quarts of air were drawn from the second pit, by means of a syringe, and preserved in a bladder. This was done a little before sunset, when the air was perfectly calm, and before the land breeze had set in. At the end of two months, another of these pits was opened ; the decomposition of the leaves was further advanced ; the ground was very damp, and the sides of the cavity were covered with grey mould : about two quarts of air had been previously drawn up by the syringe. An offensive and nauseous smell was given off, but this appeared to proceed partly from a small land crab, which had got in, and was in a state of decomposition. At the end of three months,

another pit was examined, the leaves were still farther decomposed ; there was about a pint of black turbid water at the bottom, and the sides of the cavity were covered with mould, and an offensive mouldy smell was given off. About six ounces of the water, and a quart of the air, were collected. At the end of four months, another pit was examined ; the leaves were black and decayed, admitting of being rubbed into a soft pulp between the fingers : the same faint and sickly odour was perceived as on the former occasion ; the bottom was damp, and the sides mouldy, with, here and there, small portions of a gelatinous-like matter. On examining the other two pits, the earth in one had fallen in, and the sixth had been disturbed. The air taken from the wards, and from the pits above-mentioned, was submitted to the following examination when collected.

Being destitute of chemical instruments, I was obliged to make what I required, and they were consequently imperfect. A six ounce phial was selected of nearly uniform diameter, and graduated by pasting a slip of paper, divided into 100 parts, along its side : this was intended to be used as a mercurial trough, and six pounds and a half of quicksilver, was all I could procure. An eight ounce phial of the same description, was graduated in like manner. The mercury in the six ounce phial, was displaced by air taken from the space beneath the floor of the ward, and the phial covered with a piece of linen wetted with rectified spirit. From the cold produced by evaporation, a copious precipitation of dew took place on the inner surface, and the mercury rose from the condensation of the air. On removing the cloth, the phial and the contained air soon acquired the temperature of the atmosphere, and the dew was taken

up. Part of the air was now displaced by two ounces of lime water, and on agitation, a slight milkiness was observed, and this was rendered more apparent, when compared with the same quantity of lime water agitated in atmospheric air; the mercury rose a little, but the air which had been absorbed did not exceed a hundredth part of that employed.

The phial was again filled with the same air, and about half an ounce of liquor potassæ introduced, and the bottle agitated. On opening it under mercury, about the same quantity of air was displaced, as on the former occasion. It was, therefore, inferred, that the air from beneath the floor of the ward, was saturated with moisture, and contained perhaps a little more than a hundredth part of its volume of carbonic acid. No trace of sulphuretted hydrogen could be detected.

The air, taken from the pits in the Pallisades, showed traces of both these gases. On using the same apparatus, and introducing a piece of caustic potash, moistened by the breath, a slight rise of the mercury took place, but the absorption of the gas was about the same as in the air from the ward. On introducing a solution of the acetate of lead, it acquired a darker colour, but the tinge was very slight. A slight change was also apparent in a solution of sulphate of copper. Another bottle was now taken, and carbonate of lead (prepared from acetate of lead and carbonate of ammonia) introduced diffused in a little water. The change of colour was scarcely apparent. The water obtained from one of the pits in the Pallisades, had a salt disagreeable taste, and offensive smell; and had evidently percolated through the soil, as the bottom of these pits was about the level of the sea, and within forty yards of the salt

water. When diluted with water, it blackened carbonate of lead, and formed a precipitate with nitrate of silver; from which it was inferred, that it contained sulphuretted hydrogen, common salt, and animal and vegetable matter.

The gelatinous matter alluded to, as having been found in one of the pits, was of a slight brownish tinge, and of the consistence of jelly; it had a faint odour, somewhat resembling that of sea weed. Throughout the mass, minute dark coloured spots were observed, and it had a somewhat lobulated appearance: about two drachms was collected. On diffusing half a drachm through four ounces of water, the fluid was rendered turbid, by the addition of a little infusion of galls, and blackened by the nitrate of silver. On exposing a portion in a cup, it dried up, leaving very little behind. No trace of organization could be observed, and it bore some resemblance to the gelatinous matter found in a recent sponge.

From these experiments, which were conducted with the greatest care, and with all the accuracy my imperfect instruments would admit of, it was inferred that, in the wards of the Hospital, and in the Pallisades, at Port Royal, where a constant perflation of fresh air was maintained by the alternation of the land and sea breezes, no material could be generated likely to prove injurious to health; and that the origin of those epidemic visitations, which frequently commit such ravages amongst our soldiers and seamen, must be attributed to other causes than emanations from the soil.

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